XL. *On the Fossil Flora of Bovey Tracey.* *By Dr.* Oswald Heer, *Professor of Botany, and Director of the Botanical Gardens in Zürich.* *Communicated by Sir* C. Lyell.

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In the middle of the extensive plain which is bounded by the slopes of Bovey, are the potteries of Mr. Divett, for which fuel was formerly supplied by the lignite excavated there. In order to obtain this lignite a deep cutting has been made, and a sort of small ravine formed, on the sides of which the stratification is exposed. The surface-covering consists of a light-coloured quartzose sand, which contains here and there considerable beds of white clay. By the plants contained in it this formation is assigned to the Diluvium. Immediately under it come the beds of clay and lignite described by Mr. Pengelly in the foregoing paper, which are all referable to *one* formation, as several kinds of plants are common to the different beds. The *Sequoia Couttsiæ* and *Pecopteris lignitum* occur in the 7th, 17th, 26th, 40th, and 63rd beds. *Carpolithes Websteri* is certainly found in the greatest abundance in the 54th bed, yet occurs also, though very rarely, in the 25th bed; *Cinnamomum Scheuchzeri* and *C. lanceolatum* in the 17th and 26th. The formation to which these strata belong is far older than that of the overlying white clay; the plants found in the former prove them to belong unquestionably to the *Miocene* period, and accordingly we must treat of them separately.

A. *The Miocene Formation of Bovey.*

Of the fifty species of plants which have hitherto been discovered in the lignite beds of Bovey, twenty-one occur also on the Continent in the Miocene formation. The lignite of Bovey Tracey is therefore undoubtedly Miocene; and it is worthy of special remark, that the species of *Cinnamomum* which are so characteristic of the Miocene and so generally distributed through it make their appearance in Bovey precisely as in the lignites and molasse of the rest of Europe. Equally characteristic are the *Lastræa Stiriaca*, the fern of most universal distribution over Miocene Europe, the ornate striated seeds of the *Gardenia Wetzleri*, and the fruits of *Carpolithes Websteri*, which are known to us from Germany, Switzerland, and Italy.

The following conspectus exhibits the proportions in which some of the species found at Bovey have been observed in other districts:—

	Tongrian.	Aquitanian.	Mayencian.	Helvetian.	Œningian.
Lastræa Stiriaca, *Ung.*, sp.	.....	Monod; Hohe Rhonen; Paudèze; Wetterau; Ménat; Cadibona.	Radoboj; Eriz; Riethhäusli and Ruppen, St. Gallen.	.....	Albis, very rare; Parschlug; Sarzanello.
Pecopteris lignitum, *Gieb.*	Weissenfels	Thônens, Savoy; Manosque, Provence; Wetterau.	.....	.....	.....
Sequoia Couttsiæ, *m.* ...	Hempstead, Isle of Wight.	Armissan, near Narbonne.	.....	.....	.....
Palmacites Dæmonorops, *Ung.*, sp.	.....	Salzhausen	.....	.....	.....
Quercus Lyelli, *m.*	.....	Altsattel in Bohemia.	.....	.....	.....
Laurus primigenia, *Ung.*	Sotzka; Bornstedt; Weissenfels; Salzedo; Novale.	Rivaz; H. Rhonen; Spebach; Cadibona.	Eriz; St. Gallen	.....	.....
Cinnamomum Rossmässleri, *Hr.*	Haering; Mt. Promina; Salzedo.	Rothenthurm; Altsattel; Reut; Westerwald; Sagor.	Lausanne; Solitude near St. Gallen; Radoboj; Bilin.	Turin	Albis; Wangen; Parschlug; Senegaglia.
—— Scheuchzeri, *Hr.* ...	Sotzka	Common everywhere.	Common everywhere.	Common ...	Common everywhere.
—— lanceolatum, *Ung.*, sp.	Common	Common everywhere.	Common everywhere.	Rare	Very rare; Albis; Ischel.
Daphnogene Ungeri, *Hr.*	Sotzka	Lignite of Bonn; Westerwald; Manosque.	Develier	.....	Irchel; Schrotzburg; Wangen.
Dryandroides hakeæfolia, *Ung.*	Sotzka; Mt. Promina; Haering; Salzedo.	Monod; Rivaz; Rochette; H. Rhonen; Rufi; Baltenschweil; Sagor; Peissenberg; Foveagedo.	.....	.....	.....
—— lævigata, *Hr.*	Weissenfels	Monod; Rivaz; H. Rhonen; Peissenberg; Cadibona; Manosque.	.....	.....	.....
Nyssa europæa, *Ung.* ...	.....	Salzhausen; Nidda.	.....	.....	.....
Vaccinium acheronticum, *Ung.*	Sotzka; Sieblos; Haering; Salzedo; Chiavon; Taurus.	Monod; H. Rhonen; Sagor; Lignite of Bonn.	Develier; Schangnau; Radoboj; Rhön.	Petit Mont, Lausanne; St. Gallen.	Œningen; Schrotzburg; Parschlug; Senegaglia.
Andromeda vacciniifolia, *Ung.*	Sotzka; Taurus ...	Monod.	Mönzlen	.....	.....
—— reticulata, *Ett.*	Hempstead; Haering; Sieblos.	.....	.....	.....	.....
Echitonium cuspidatum, *Hr.*	.....	Manosque	.....	.....	Locle.
Gardenia Wetzleri, *Hr.*..	.....	Salzhausen; Samland.	Rhön; Günzburg; Ruckers.	.....	.....
Nymphæa Doris, *m.*	Hempstead	.....	.....	.....	.....
Eugenia Hæringiana, *Ung.*	Haering; Sieblos; Reut.	Ralligen	Lausanne; Calvaire; St. Gallen; Rhön.	Petit Mont, Lausanne; Turin.	.....
Celastrus pseudo-ilex, *Ett.*	Haering	.....	Rhön	.....	Locle; Œningen; Hohen Krähen; Bischofsheim.
Carpolithes Websteri, *Br.*	Hempstead	Rochette; Conversion; Westerwald; Salzhausen; Laubach; Cadibona.	Rhön; Eisgraben; Zeche Einigkeit; Kaltennordheim.	.....	.....

A glance at this Table will at once satisfy us that the lignites of Bovey must be referred to the Lower Miocene division, and to the Aquitanian stage of it. It is true that nine of the species are found also in the Upper Miocene of other places, but these are all species which occur also in the lower stages, and which had a very extensive distribution both in time and space. Twelve species have been observed in the Mayencian and sixteen in the Tongrian stage; but nineteen have been identified in the Aquitanian stage in various localities. Certain species (*Palmacites Dæmonorops*, *Quercus Lyelli*, and *Nyssa europæa*) are not yet known in other districts as belonging to any but the Aquitanian stage; two (*Andromeda reticulata* and *Nymphæa Doris*) are known only in the Tongrian; others (*Pecopteris lignitum*, *Sequoia Couttsiæ*, *Dryandroides hakeæfolia*, and *D. lævigata*) only in the Tongrian and Aquitanian.

In this conspectus we have omitted the doubtful species (*Phragmites Œningensis*, *Dryandroides Banksiæfolia*, *Eucalyptus oceanica*, and *Pterocarya denticulata*). Should these be established by specimens in a better state of preservation, no disturbance would ensue to the above result, inasmuch as the *Phragmites* reaches back to the Lower Miocene, the *Eucalyptus* and *Dryandroides* belong to the Tongrian and the Aquitanian, the *Pterocarya* to the Aquitanian.

If we compare the Bovey flora with the several Continental floras, we shall find a great coincidence between it and that of Salzhausen in the Wetterau. A couple of species, viz. *Palmacites Dæmonorops* and *Nyssa europæa*, were previously known only from that district, while others, as *Pecopteris lignitum*, have been rarely found in other localities. With the Aquitanian stage of the Swiss Molasse (Hohe Rhonen, Ralligen, Monod and Rochette) Bovey has eleven species in common,—all species which occur in other parts, but two of them (*Dryandroides hakeæfolia* and *D. lævigata*) are especially frequent in Switzerland.

Of the French tertiary floras, it approximates most to that of Manosque in Provence. Here, as at Bovey, the most frequent fern is *Pecopteris lignitum*; and here also are found *Cinnamomum lanceolatum*, *Daphnogene Ungeri*, *Echitonium cuspidatum*, and *Dryandroides lævigata*. The water-lily of Bovey is probably one with the *Nymphæa calophylla*, Sap., of Manosque; but this cannot be determined, as we have only the leaves in the latter case, and the seeds in the former.

In the composition of the soft clay that contains the plants in the 26th bed at Bovey, and in the mode of their deposition in the same, there is great resemblance to the clays of Samland near Königsberg. A further connexion may also be traced through *Gardenia Wetzleri*.

It is remarkable that Bovey has no species in common with Iceland, although the tertiary flora of Iceland belongs to the same period, and two of its species (*Corylus MacQuarrii*, Forbes, and *Platanus aceroides*, Gp.) extend into Great Britain, having been found in Mull, in the Miocene of Ardtun Head. Even the genera are distinct, with the exception of two, *Sequoia*, and *Quercus*, which genera have each a single but distinct species in Iceland and in Bovey. The Bovey flora has a much more southern

character, corresponding entirely with that of the Lower Miocene of Switzerland. Bovey had three species of cinnamon, one laurel, evergreen fig-trees, one palm, and large ferns, thus manifesting a subtropical climate.

If we compare the Bovey flora with that of the Eocene beds of the Isle of Wight, we find certainly some points of connexion, but, on the whole, an essentially different character. As connecting points, we may observe that one species (viz. *Laurus primigenia*, Ung.) is common to Alum Bay and Bovey, and, moreover, that the genera *Quercus*, *Ficus*, *Dryandroides*, *Daphnogene*, and *Sequoia* appear in both places, although differing in species. The fact of only one species being found in common at so short a distance —that in the Eocene formations of the Isle of Wight the highly characteristic Cinnamon and Lastræas are wanting—above all, the fact that Bovey has many more species in common with the more remote Miocene formations of the Continent than it has with Alum Bay and Bournemouth, satisfies us that it belongs to a different horizon*.

In this summary we have noticed only the species already known. Among the new species, however, of which I have described twenty-six, several interesting forms are found. The first place belongs to the *Sequoia Couttsiæ*, m., a Conifer, which we can illustrate by branches of every age, and by the cones and seed. It supplies a highly important link between *Sequoia Langsdorfi* and *Sequoia Sternbergi*, the widely distributed representatives of *Sequoia sempervirens*, Lamb., and *Seq. gigantea*, Lindl. (*Wellingtonia*), which latter species are at present confined to California.

Of great interest also are two species of *Vitis*, of which the grape-stones lie in the clays of Bovey. They belong to different species from the tertiary vine of the Continent (*Vitis teutonica*, A. Br.); but it is not improbable that they may be identified with that of Iceland (*Vitis islandica*, m.), though we must leave this indeterminate for the present, as we have obtained only the leaves from Iceland, and only the grape-stones from Bovey. The three remarkable species of fig, the seeds of three new species of *Nyssa* and two of *Anona*, one new water-lily (*Nymphæa*), and many highly ornate *Carpolithes*, are important additions to our knowledge of tertiary plants.

If from the relics of Bovey plants, which are still far from numerous, we attempt to represent the vegetation of Bovey as it existed in the tertiary period, we shall have to sketch it somewhat in the following manner:—The woods that covered the slopes which surrounded the beds of lignite consisted mainly of a huge coniferous tree (*Sequoia Couttsiæ*), whose figure resembled in all probability its highly admired cousin the *Sequoia* (*Wellingtonia*) *gigantea*, Lindl., of California. It had just the same graceful slender appearance in its vernal shoots, thickly studded with leaflets; and the similarity continued in the older shoots and branches, which were clothed with scales. But it presented a distinct character in its shorter leaves, which were even more closely appressed to the shoots, and in its smaller cones. The leafy trees of most frequent occurrence were

* I received lately from Mr. Pengelly a collection of plants from the Tongrian stage of Hempstead (Isle of Wight); it contains four Bovey species, viz. *Sequoia Couttsiæ*, *Andromeda reticulata*, *Nymphæa Doris*, and *Carpolithes Websteri*.

the cinnamons (*Cinnamomum lanceolatum* and *C. Scheuchzeri*) and an evergreen oak (*Quercus Lyelli*, m.) like those which now are seen in Mexico. The species of evergreen fig were rarer, as were also those of *Anona* and of *Gardenia*. The trees of the ancient forest were evidently festooned with vines, beside which the prickly Rotang-palm (*Palmacites Dæmonorops*) twined its snake-like form. In the shade of the forest throve numerous ferns, one species of which (*Pecopteris lignitum*) seems to have formed trees of imposing grandeur; besides which there were masses of underwood belonging to various species of the genus *Nyssa*, which is at present confined to North America. On the surface of the lake in which were formed the deposits of clay and sand that lie between the lignite-beds, were expanded the leaves of those water-lilies the ornate seeds of which are preserved for our examination.

If we inquire further how far the plants help us to a definite view of the course of events by which these lignite-beds were formed, our conclusions will be somewhat of the following kind:—

It is highly probable that at the period of the Lower Miocene the Bovey basin was occupied by an inland lake. The entire absence of freshwater shells, and indeed of aquatic animals generally, is certainly very extraordinary; and so is the absence of fruits of *Chara*, which abound elsewhere in Miocene freshwater deposits; the *Nymphæa* seeds, however, afford positive proof of fresh water. We must not omit to notice that the parts of the basin hitherto explored, and the only parts which are accessible to investigation, lie at a great distance from the hills. Accordingly they were far from the bank, more in the middle of the lake, and, in the case of the lower beds, at a considerable depth. This explains the absence of bog plants, so numerous in other instances, as well as the absence of mammalian relics. These would not have drifted so far out into the lake, and probably they are to be found on the edge of the lignite formation, where the vegetation also may be expected to present a somewhat different character. The lignite-beds of the under series consist almost entirely of tree-stems (probably belonging in great measure to *Sequoia Couttsiæ*); these alternate with masses of a brownish-black clay, the dusky colour of which has doubtless been produced by the decomposition of the softer portions of the plant. No leaves offer themselves for recognition, but here and there twigs and seeds of *Sequoia Couttsiæ*, and little fruits, as *Carpolithes Websteri* and *C. nitens*. The tree-stems, which are here piled one over the other in huge masses (none of them stand upright), and which every here and there stretch their branches and roots in the layer of clay which has covered them up, have apparently been floated hither, not only from the immediate circuit of hills, but doubtless also from greater distances. Such a mass of timber could hardly have been furnished by the former. Accordingly we learn from the structure of these lignite-beds that they did not originate in a tertiary peat-deposit, but from a colluvies of wood uniting in a lake; and hence they differ widely from those of Paudèze, of Hohe Rhonen, of Käpfnach, and other localities of Switzerland. At the same time the lignites of Bovey must have taken a long period in the process of formation, as the repeated alternations of clay-beds sufficiently show.

When a mass of timber and mud had been deposited in the bottom of the Bovey lake, some natural disturbance (whether owing to extensive landslips falling into the lake, or to the river undermining its banks) must have occasioned the contribution of a mass of quartzose sand, which thickly covers the under set of lignites, and which must at the time have helped largely to fill up the lake. Immediately above it lies a soft clay with numerous leaves of plants (the 26th bed), just as they were drifted together from the woods in the fall of the year. It seems, then, that this bed was formed in autumn, and that the plants it contains are due to the driftings of that season; in further confirmation of which, is the frequent recurrence of the seed and ripe cones of *Sequoia Couttsiæ*. Higher up follows the bed with the fern-rhizomes, among which occasionally can be recognized the pinnules of *Pecopteris lignitum*, which, somewhat higher up, amidst the branches of the *Sequoia*, appear in great abundance, being here and there compacted together in dense masses.

Above this bed come strata of clay and comparatively inconsiderable deposits of lignite, which last were all formed from the collection of wood and plants drifted to the spot.

As this Lower Miocene formation is immediately succeeded by quartzose sand with White Clay, we have here a great hiatus. Either the Middle and Upper Miocene, as well as the Pleiocene periods, must have passed without the formation of deposits in this place, or the latter must have been removed during the Diluvial period.

B. *The White Clay.*

While the lignites and their alternating clays at Bovey present us with a vegetation which is subtropical, the plants of the White Clay exhibit a totally different character, and must have had their origin in a period altogether distinct. The collection of Mr. PENGELLY contains four species from this formation—three of *Salix* and one of *Betula*; and, what is the most remarkable, none of these appear to me to differ from species now living. The little birch-leaves are not to be distinguished from those of *Betula nana*, Linn., nor the willow-leaves of one species from those of *Salix cinerea*, Linn.; while those of a second species come very near *Salix repens*, Linn., and also resemble strongly those of *Salix ambigua*, Ehrh. So variable is the form of these leaves, that it is hard to fix the species with positive certainty. At all events these leaves prove to us that those white clays must be much more recent than the lignite deposit; while the presence of *Betula nana*, Linn., which is in the highest degree remarkable, is conclusive for a diluvial climate, that is, a colder climate than Devonshire has at the present day; for this dwarf birch is an Arctic plant, which has no British habitat south of Scotland, and which occurs in Mid Europe only on mountains and subalpine peat-mosses. The evidence of the willow-leaves is to the same effect, indicating that at this period Bovey was a cold peat-moor. We may remark that *Salix cinerea*, Linn., is one of the most prevalent species of the diluvial travertine of Kannstatt.

I. *Descriptions of the Miocene Species of Plants.*

I. CRYPTOGAMÆ.

I. FUNGI.

1. Sclerotium, Tode.

1. Sclerotium Cinnamomi, m. (Plate LXVII. fig. 17; fig. 19, magnified; diameter magnified, 19 *b*.)
Scl. perithecio orbiculato, duro, plano, margine elevato.

On the leaf of *Cinnamomum Rossmässleri* there are several flat circular umbos. They are 1 millim. in diameter. They are quite smooth and flat in the centre, and surrounded by a very sharp edge.

They very much resemble *Sclerotium pustuliferum*, Heer, which is often found on *Quercus neriifolia* in Oeningen. Of the living species, *Scl. pustula* may be compared with it. Rossmässler has figured a closely resembling, but somewhat larger fungus, in his 'Beiträgen zur Versteinerungskunde,' taf. 8. fig. 27.

2. Sphæria, Hall.

2. Sphæria socialis, m. (Plate LXV. fig. 13, *c*; fig. 13, *c c*, magnified.)
Sph. peritheciis congregatis, minutissimis, orbiculatis, ostiolo rotundato pertusis.
In the 17th bed at Bovey.

There are many circular and convex little bodies close together on a leaf of *Dryandroides lævigata*, Heer. In the centre they are furnished with a pretty large aperture.

3. Sphæria lignitum, m. (Plate LV. fig. 1; figs. 2 & 3, magnified.)
Sph. peritheciis gregariis, liberis, conicis, nigris, apice nitidis, papillatis, ostiolo minuto, orbiculato.

I found this *Sphæria* on the bark of several branches, which perhaps belong to *Sequoia Couttsiæ*. They were lying in the 26th bed, beside some young branches of *Sequoia*. The perithecia form little black warts, which are clustered together in great numbers; the largest $\frac{1}{2}$ millim. in diameter; many of them are much smaller, and appear as black points. The largest of them are slightly conical, and furnished on the top with a very small though distinctly separated cicatricule. When this cicatricule falls away, a small aperture is left. In many of them a transverse slit has originated near the base, and the upper part of the perithecium has fallen away; thus we have a large aperture, surrounded by the pretty thick coat of the perithecium.

This belongs to the group of *Sphæriæ pertusæ*, Fries (Systema Mycolog. ii. p. 460), and has a great resemblance to *Sphæria umbrina*, which, however, is much larger and flatter.

II. FILICES.

1. Lastræa, Bory, Alex. Braun. (*Phegopteris*, Mettenius.)

4. Lastræa (Goniopteris) Stiriaca. (Plate LVI. figs. 12–15.)

L. fronde pinnata, pinnis linearibus, prælongis, grosse crenatis serratisve, nervis secundariis e nervo primario angulo subacuto egredientibus, pinnatis, nervis tertiariis utrinque plerumque 6–7, curvatis, subparallelis, angulo acuto egredientibus, soriferis; soris rotundatis, biseriatis.

Heer, Flora Tertiaria Helvetiæ, i. p. 31; iii. p. 151; pl. 6, 7, 143, figs. 7 & 8.

Polypodites stiriacus, Unger, Chloris Protogæa, p. 121, pl. 36.

This is the tertiary fern which has the widest distribution. It appears rarely in the Upper Molasse, however (on the Albis, in Parschlug and Sarzanello), but very often in the Aquitanian stage of the Lower Miocene formation—thus at Monod, the Paudèze, Hohen Rhonen, &c., in France at Ménat, and in Italy at Cadibona. Several portions of leaves have been found at Bovey, the determination of which is undoubted. The leaf figured in fig. 15 represents a pinnule in almost its whole length; the other figures represent parts of leaves, the nervation of which is well preserved (Plates LVI. fig. 12; LVII. fig. 8). The specimen Plate LVI. fig. 14 is a portion of a leaf with the rachis, on the side of which the pinnules are attached. The pinnule is long and narrow, with parallel sides, deeply toothed, the teeth bent towards the apex; their long side forms an arch, the sinus is acute. The principal nerve of the pinnule is strong, the secondary nerves are fine, springing at acute angles and forming a slight arch; from each secondary nerve spring, on the inner side five or six, and on the exterior side six or seven, but seldom eight, tertiary nerves. They are strongly bent upwards, and united exactly in the same manner as in the specimens I have described in the 'Flora Tertiaria Helvetiæ' (vol. i. p. 31). At Bovey, hitherto, only sterile leaves have been found, whilst Monod has furnished pinnæ covered with sori (cf. Plate LVI. fig. 13). The sori are in the middle, or a little outside the middle of the tertiary nerves; they are round, small, and ranged in two lines, converging towards the apex. We see, from the specimens discovered at Monod, that this species was a very large one. The leaves attained probably a length of 3 feet and a diameter of at least 1 foot. The pinnules are very distant from each other at the base of the leaf, whilst above they approach and get gradually shorter. Most of the specimens are from the 17th bed of Bovey, I saw, however, one in the clay of the 26th bed.

Lastræa Stiriaca most resembles *L. prolifera*, Kaulf. (*Phegopteris prolifera*, Metten.), of tropical America, and belongs to the genus *Lastræa* (div. *Goniopteris*), as Alex. Braun has established it (cf. Flora Tertiaria Helvet. i. p. 30, and iii. p. 150).

5. Lastræa Bunburii, m. (Plate LXIII. fig. 1, *b*; magnified, *c*, *d*.)

L. fronde pinnata (?), pinnis linearibus, apicem versus angustatis, argute serratis, nervis secundariis flexuosis, e nervo primario angulo subacuto egredientibus, pin-

natis, nervis tertiariis utrinque 2–4, subflexuosis, curvatis, angulo acuto egredientibus.

Only a portion of a leaf, of 71 millims. in length; it occurred in the clay of the 26th bed. At the base it was probably 19 millims. in diameter; towards the apex it gradually tapers; therefore it must probably have had a long apex, which however is not preserved. It very much resembles the former species, but differs by the tapering form, the smaller and very acute teeth, and the fewer tertiary nerves, which are undulated. A comparison with fig. 4, pl. 8 of the 'Flora Tertiaria' shows that it is not the exterior part of the former species. It approaches more to *L. helvetica*, Hr. (Flora Tertiaria, i. p. 33, iii. p. 151), in the tapering of the pinnules, notwithstanding the fewer tertiary nerves and the undulated secondary nerves. It differs from *Aspidium dalmaticum*, Ett., in the smaller teeth, and fewer tertiary nerves.

The margin is provided with very small and sharp teeth, which are very much bent towards the apex. The secondary nerves are thin, strongly undulated, and have on the under side mostly four, sometimes but three, on the upper one two or three tertiary nerves, which are also undulated. The lowest one is united with the lowest of the next secondary nerves, and forms with it a triangular acute areole, out of which springs a branch that advances to the next sinus. A little higher it is joined by two united tertiary nerves, also at an acute angle, and immediately under the sinus another one. This nerve directed to the sinus is also undulated.

2. Pecopteris, Br.

6. Pecopteris (Hemitelia?) lignitum, Gieb. (Plate LV. figs. 4–6; LVI. figs. 1–11; LVII. figs. 1–7, magnified.)

P. fronde pinnata, pinnis linearibus, longis, apice valde attenuatis et acuminatis, basi plerumque breviter petiolatis, profunde inciso-serratis, nervis tertiariis furcatis, inferioribus valde curvatis, sinum attingentibus.

Pecopteris lignitum, *P. crassinervis*, *P. leucopetræ* et *P. angusta*, Giebel, "Paleontolog. Untersuchungen," Zeitschrift für die gesammten Naturwissenschaften, 1857, p. 305, pl. 2. fig. 2.

Aspidium lignitum, Heer, Beiträge zur nähern Kenntniss der sächsisch-thüringisch. Braunkohlenflora, p. 424, pl. 9. figs. 2 & 3.

Aspidium Meyeri, Ludwig (non Heer!), Palæontograph. viii. 2. p. 63, pl. 12. fig. 3.

This is the commonest fern at Bovey; it and *Sequoia Couttsiæ* are the plants most commonly met with in this locality; the petioles and pinnules are heaped up in the 17th and 26th bed. They are only separated by thin layers of clay. On dissolving this, one is able to take the leaves out of it and preserve them in fluid (spirit, glycerine, water). They decompose in the air.

This species had a large distribution in the tertiary period, but is confined to the

Tongrian and Aquitanian stages. It has been found at Weissenfels in Saxony, at Salzhausen and Münzenberg, at Thôrens in Savoy, and at Manosque in Provence.

Hitherto no perfect leaves or pinnules have been found at Bovey, but so many portions of pinnules that one can easily put together the entire pinnule, as we have tried to do in Plate LVI. fig. 8. The pinnule is in length 173 millims., its extreme breadth 21 millims.; it gradually tapers towards the apex, and forms a long sharp point (Plate LVI. figs. 2–4, and magnified fig. 1). The pinnule is also narrower at the base than in the middle; at least several pieces evidently belonging to the base are narrower than those from the middle of the pinnule (fig. 5). The pinnule is shortly petioled, and has often unequal sides at the base. There are many such pinnules around a finely striated rachis; portions of which latter common rachis are often found (cf. Plate LV. figs. 5, 4 *a*, & 8) between the pinnules, and in several cases I have seen the lateral pinnules attached.

The pinnules are of a strong, almost leathery consistence, and, examined with a lens, they appear to be finely punctate. Their margin is deeply toothed, the broad portions in the middle of the pinnule are nearly pinnatifid, the teeth on the outer margin smaller, and closer together. All these teeth are strongly bent towards the apex; the long side forms a strongly-curved arch; they are entire, and provided at the tip with a distinctly separated little tooth. The midrib is pretty strong; the secondary nerves spring at the base of the leaf in slightly acute angles, and in more acute ones in the upper narrower part of the pinnule. They are mostly more or less curved, and on each side they send forking tertiary nerves, on the upper part (nearer the tip) mostly one or two less than on the lower one. The broad pieces of pinnules have on the lower side seven or eight tertiary nerves; the number lessens nearer to the tip, as the pinnules gradually taper (we count there 6, 5, 4, 3, 2), and quite near the tip they are undivided (fig. 1). Each of the tertiary nerves soon divides into two branches, which do not again divide; only the exterior ones remain entire. Those tertiary nerves are everywhere equally strong, and sometimes the fourth or fifth advances to the margin, whilst the following one is again forking. The lowest ones are very strongly curved, and enter the sinus always between two teeth. The lowest tertiary nerves do not generally join the nerve of the neighbouring pinnules (Plate LVII. figs. 1, 4 & 5), or only in the sinus, forming a very acute-angled triangle (figs. 3 & 7). In some cases they unite like *Goniopteris*, already a little lower (Plate LVII. fig. 2), forming several very acute-angled arches. The tertiary nerves mostly spring from the secondary; but sometimes a fine forking nerve immediately springs from the principal nerve (Plate LVII. figs. 1–5), and runs to the sinus of the teeth.

A portion of a leaf very different in the nervation is figured in Plate LVII. fig. 6 (magnified). The tertiary nerves spring at very acute angles; they are very numerous, and some of them are twice forked. The teeth seem to have been narrower and longer. This fragment may belong to another species, but is too imperfect to pronounce any

opinion upon. Beside the pinnules of the leaves, we often find at Bovey circinate young shoots of ferns (Plate LVI. figs. 9, 10 & 11), which probably belong to the species in question, as being the commonest one.

Professor GIEBEL, who first established this species, has given it four names: his *Pecopteris leucopetræ* represents the apex of the leaf, *P. angusta* a portion of the pinnule a little below the apex, where the tertiary nerves spring at acute angles, and *P. lignitum* and *P. crassinervis* the broader lower part of the pinnule.

LUDWIG has confounded this species with *Aspidium Meyeri*, Heer. The portion of a leaf from Münzenberg, figured by him in pl. 12. fig. 3 of the 'Palæontographica,' entirely differs from *A. Meyeri*, in the shallower incision and different nervation. It belongs to *P. lignitum*. It seems to me that the portion of a leaf figured by him in pl. 10. fig. 2, belongs to another species.

I have formerly assigned this fern to the genus *Aspidium*, because the secondary nerves are usually forked, and the tertiary nerves often jointed like *Goniopteris*; but a close examination of the numerous and well-preserved fragments from Bovey has convinced me that they do not belong to *Aspidium*. The pinnules had a hard, nearly leathery structure; and the peculiarly curved lower tertiary nerves, which run in large arches, differ from *Aspidium*, and very much remind one of *Hemitelia*. The tertiary nerves of the Hemitelias are most of them jointed by small nervules; but still there are species in which this is not the case (ex. gr. *H. integrifolia* and *H. speciosa*), and in *H. Karsteniana* (cf. Mettenius, Icones Filicum, pl. 29. fig. 2) there is a variety the nervation of which has more likeness to that of *Pecopteris lignitum* than to any other species of fern known to me; therefore the species in question probably belongs to the genus *Hemitelia*. It may, however, be better in the meanwhile to preserve the name *Pecopteris* till the fruits are found, which certainly will be soon, this species being so common at Bovey. I have, however, sought in vain for sori amongst many hundreds of pinnules. Sometimes little round spots are seen which look like sori (Plate LV. fig. 4 *d*); but a careful examination shows that they are accidental markings, some of them upon the tertiary nerves, and others beside them.

In the 25th bed at Bovey (rarely in the 17th) we often find large rhizomes quite covered with petioles, which, I suppose, for the following reasons, to belong to *Pecopteris lignitum*.

1. In several pieces, I found between the petioles the pinnules of *Pecopteris lignitum*, though not attached.

2. In the lignites of Salzhausen quite similar rhizomes are found with pinnules of *Pecopteris lignitum* (cf. Ludwig, in the 'Paleontographica,' viii. p. 64, pl. 10. fig. 3); therefore LUDWIG has compared it with this species (his *Aspidium Meyeri*).

3. The petioles are striated in the same manner as the petioles which are so often lying between the pinnules of *Pecopteris lignitum*, and which undoubtedly belong to one plant, as in some cases I saw them attached (Plate LV. fig. 4).

4. The rhizomes and the petioles are mostly curved towards one side; therefore the

rhizomes probably lay horizontally on the earth, and the leaves arched upwards, as we see in existing ferns.

The stems, and the petioles which cover them, are converted into coal; therefore a microscopic examination is not possible. The considerable thickness of the organs surrounding and covering the stems shows us that they are petioles, and not leaves. Though they are very much compressed, the thickness of the mass of coal is nearly always several millims.

The large specimens remind us directly of the pinnated leaves of palms (Plate LVIII.). On examining them minutely, we see that the supposed pinnules are not fastened in two rows on the rachis, but that they are placed around it spirally; therefore they cannot be pinnules of leaves; they are organs fastened on a stem; and as they are tapered at the base, and inserted on the stem with a tapering but not sheathing base, they cannot at all events be the leaves of a monocotyledonous plant. The leaves of ferns are inserted in that manner on the stem, and taper also sometimes towards the base. In most of the Aspidieæ, Asplenieæ, and Cyatheæ the petioles are continuous with the stem; they remain after the withering of the leaves, and form a thick and dense cover over the rhizome, as they do in the Bovey plant. It is remarkable that roots are seldom seen on these rhizomes; but in several specimens thread-like bodies can be seen between them, which probably were fibrils; and there are, further, some specimens which indicate that the numerous fine undulated striæ, which at some places are lying in heaps, are probably hairy scales which have covered the petioles.

The largest specimen is $7\frac{1}{2}$ decim. long and 2 decim. broad. It is pretty strongly curved. The petioles are lying in heaps one upon another, and therefore must have covered the stem. In some specimens the stem is denuded here and there. It is quite converted into coal, and it is therefore as impossible to examine its anatomical structure as that of the petioles. These are of a considerable length, and always irregularly broken; their length therefore varies. I have collected great numbers of specimens at Bovey, and hoped to have been able to find the connexion of the petioles with the pinnules of *Pecopteris*, but was unsuccessful, though these rhizomes are in heaps in the 25th bed. The petioles gradually taper towards the base, which is rounded; they never sheath. Many specimens distinctly show that the petioles are not distichous, but are imbricated all round the stem. They are compressed, but the edges are defined.

At the same place there are portions of rhizomes provided with the cicatricules of roots (Plate LVIII. fig. 3). These are orbicular, 3 millims. in diameter, and consist of an elevated margin, surrounded by an orbicular depression, or, instead of this, they present a central wart, evidently originating from the central fibre. They are in pretty large numbers together, without being ranged in fixed order. The stems of living ferns have similar cicatricules of roots. The *Stigmaria*? of Altsattel, according to Rossmässler*, probably represents also a portion of the stem of a fern with the cicatricules.

* Beiträge zur Versteinerungskunde, pl. 12. fig. 58.

7. PECOPTERIS HOOKERI, m. (Plate LVIII. fig. 3.)

P. pinnis elongato-lanceolatis, anguste serratis, nervis secundariis furcatis.

I have seen only a drawing (Plate LVIII. fig. 3) which Mr. FITCH has made. He assured me that the nervation and the natural size of the leaf were truly represented. The leaf seems to be lost; for it could be found neither in London nor at Mr. PENGELLY'S, at Torquay. It consists of a pinnule*, the base and point of which are wanting. It is toothed, the teeth sharp and bent towards the apex, the secondary nerves partly alternate, partly opposite, each of them divided into a simple fork. The branches of the fork run to the teeth.

II. PHANEROGAMÆ.

A. Gymnospermæ.

Order CONIFERÆ.

Fam. ABIETINEÆ, Rich.

1. SEQUOIA, Endl.

8. SEQUOIA COUTTSIÆ, m. (Plates LIX., LX., LXI.)

S. ramis alternis, rarissime verticillatis, ramulis junioribus elongatis, gracilibus; foliis squamæformibus, imbricatis, subfalcatis, medio dorso costatis, basi decurrentibus; strobilis globosis vel subglobosis; squamis peltatis, medio brevissime mucronulatis, rugosis; seminibus alatis, compressis, nucleo paulo curvato.

This and *Pecopteris lignitum* are the commonest plants of Bovey, and their stems certainly contribute the greatest amount of lignite. Larger and smaller branches of this tree occur in the 17th and 26th beds of the clay. Entire cones (as represented in Plate LIX. figs. 1, 14, 16 & 18), seeds, and scales of cones have been found in great numbers. It is certain that the cones and seeds belong to one plant; for they not only agree with those of *Sequoia*, but in several cases I have seen the seeds lying in their natural position under the cone. But it might be questioned if all those branches the principal forms of which are represented in Plates LIX. and LX. belong to this same tree, because the young twigs so closely resemble those of *Glyptostrobus europæus*. A very minute comparison, however, of many specimens has persuaded me that this is not the case, and that all the figured branches and cones belong to one plant. In comparing the leaves of the twigs which bear the cones (Plate LIX. figs. 14, 16 & 18), we see that their form agrees with the loose twigs. As the principal character of these leaves, we may observe that they are nearly always somewhat falcate (cf. Plate LX. figs. 14–20). This is not the case with *Glyptostrobus europæus* (cf. Plate LX. fig. 49, magnified fig. 49 *b*,

* This form very much reminds us of *Lastræa Bunburii*, the nervation of which is however quite different.

where a twig of *Glyptostrobus* of the Hohe Rhonen is represented for comparison). The adnate scale-like leaves are straight in *Glyptostrobus*, or only somewhat curved outwards and obtuse, as in *Glyptostrobus heterophyllus*, Br. The spreading leaves are often provided with an acute and usually straight point, and, but seldom, a little curved; when this is the case, they have at all events a great likeness to our *Sequoia*.

As we have the branches, fruits, and seeds of this tree, the determination of the genus is undoubted. It resembles in all its principal points *Sequoia*, Endl. It has decurrent leaves, globose cones with peltate scales. They are provided on the surface with wrinkles radiating from a small mucro.

Several flat-winged seeds are lying under the scales. The scales and seeds very much resemble those of *Sequoia sempervirens*, Lamb., of California (cf. this cone, Plate LX. fig. 48, and the seeds of this species, fig. 47, magnified 47 *b*); but the nucleus of the seed is somewhat curved in the fossil species. The leaves are quite different, those of the sterile branches of *Sequoia sempervirens* being distichous and long linear, almost as in *Taxus baccata*, Linn. The *Sequoia Couttsiæ* approaches *S. gigantea* (*Wellingtonia*, Lindl.) in the form and position of the leaves, but differs in the much smaller cones. The Bovey species is in some measure intermediate between the two existing species.

In comparing the species of Bovey with the tertiary species of *Sequoia*, the *S. Langsdorfi*, Br., will be first taken into consideration. The cones are very similar (cf. Flora Tertiaria Helvetiæ, pl. 21. fig. 4 *d*, pl. 146. fig. 16; and Ludwig, Palæontographica, Band viii. pl. 15. fig. 1); but this species has the leaves of *S. sempervirens*. Our species still more resembles *S. Hardtii* *, the scales of the cones being of the same length and form, but Unger and Ettingshausen describe the cones as subconical, and the seeds as provided with a mucro; further, the leaves of the fertile twigs are more acute, and those of the sterile ones are linear and spreading. The Bovey species differs from *S. Sternbergi* (*Araucarites*, Gp.) in the much more slender twigs, and the different construction of the leaves. It differs from *S. Ehrlichi*, Ung., in the shorter leaves and the globose cones.

If we compare all the Sequoiæ now known, we have to place them in the following manner:—

1. *Sequoia gigantea*, Lindl.; California.
2. *Sequoia Ehrlichi*, Ung.; tertiary formation near Spital in Austria.

* *Cupressites Hardtii*, Goeppert, Monogr. der Fossilen Coniferen, p. 184.

Cupressites taxiformis, Unger, Chloris protogæa, p. 18, pl. 8. figs. 1–3, pl. 9. figs. 1–4.

Chamæcyparites Hardtii, Endl. Synopsis Conifer. p. 277; Ettingshausen, Flora von Haering, p. 35, pl. 6. figs. 1–21.

Endlicher and Ettingshausen have wrongly referred this species to *Chamæcyparis*; the leaves of which genus are opposite, and ranged in four rows round the branch, whilst they are alternate in *S. Hardtii*, as in *Sequoia*; the cones of *Chamæcyparis* are much smaller, and the seeds have a thicker nucleus, the base and point of which are not surrounded by the thin wing. This species has no doubt been referred to *Chamæcyparis* by Unger from a comparison with *Cupressus thurifera*, Humb. et Bonpl. (*Chamæcyparis*, Endl.).

3. *Sequoia Sternbergi*, Gp.*; has a wide distribution in the Miocene formation, from Senegaglia to Iceland.

4. *Sequoia Couttsiæ*, Hr.; Bovey.

5. *Sequoia Hardtii*, Gp.; Haering and Armissan.

6. *Sequoia Langsdorfi*, Br.; spread over the whole Miocene formation, in Italy, Germany, Switzerland, France, Isle of Mull, Greenland, Bear-lake River, Vancouver Island, from the Unga at the shore of Aleski, Russia near Orenburg.

7. *Sequoia sempervirens*, Lamb.; California.

The genus *Sequoia* probably begins in the cretaceous formation; for *Geinitzia* (*Cycadopsis*, Deb.) is so nearly related to *Sequoia*, that, according to Dr. Debey, it can scarcely be separated from this genus, and may be considered as the predecessor of it. This genus most abounded in the Miocene time; it was spread over the whole Continent as far as we know. In the present creation we have but two remains of this type, both found only in California. These two living species represent the two extremes of all the known forms. Of the fossil species, *S. Langsdorfi* especially approaches to *S. sempervirens*, and *S. Ehrlichi* and *S. Sternbergi* to *S. gigantea*. *S. Couttsiæ* is the intermediate species between these two principal types.

I now proceed to describe the Bovey specimens.

The annual twigs (Plates LX. figs. 9–20; LIX. and LX. figs. 7 & 8, magnified) are very slender, often of considerable length (figs. 14–16), without producing lateral twigs. The leaves cover the twigs like scales, which are mostly very close together (Plate LX. fig. 10); on the long twigs they are more distant. At the base of the young shoots they are always closer and shorter (fig. 7), a little more outwards they are more distant. The leaves are alternate, though sometimes two are nearly opposite, but never exactly so. All the leaves are decurrent at the base. The very short scale-like leaves are somewhat falcately curved (cf. Plate LX. fig. 13, magnified), and still more so are the leaves which are more distant from one another (Plate LX. figs. 14, 15 & 17). These leaves are

* I have already tried to show, in my 'Flora Tertiaria Helvetiæ,' iii. p. 317, note, that *Araucarites Sternbergi*, Gp., belonged to *Sequoia*. Massalonga has given, in his 'Specimen Photographicum,' pl. 21, a photograph of his *Araucarites venetus* of Chiavon. He said that the leaves and twigs were not different from those of *Araucarites Sternbergi*; he took it for a different species, because he thought, with Unger and Ettingshausen, that the cone presented under the name of *Araucarites Gœpperti*, St. (Sternberg, Pflanzen der Vorwelt, pl. 89. fig. 4; Goeppert, Fossile Coniferen, pl. 44. fig. 2), was to be referred to *A. Sternbergi*. But we have shown, in the 'Flora Tertiaria,' that there are no sufficient reasons for it; and the circumstance that cones are found, in Chiavon, on a twig which is not to be distinguished from *A. Sternbergi*, and also immediately beside similar twigs in Iceland (quite different from *A. Gœpperti*), confirms this opinion. The cone of Chiavon is much compressed, and lies in a lateral position, while the cones of Iceland represent the transverse section (as do the pieces represented by Sternberg, 'Flora der Vorwelt,' ii. pl. 57. figs. 1–3, as *Steinhauera subglobosa*, Presl, which, according to my opinion, belong to this species). The scales of the cones are small and in great numbers, and very different from *Araucaria*, while the cone figured by Massalonga has a great resemblance to that of *Sequoia gigantea*. The seeds represented as *Steinhauera* quite agree with *Sequoia*.

acuminate, and the point is curved outwards (Plate LX. fig. 14 *b*, somewhat magnified). Amongst the great number of twigs I have seen, there was only one with much longer linear leaves (Plate LX. fig. 12, magnified fig. 12 *a a*) than they commonly appear in *Sequoia Hardtii*. Twigs with such long leaves therefore must be very rare. The small portion of a twig which is represented in fig. 9 (magnified) forms the intermediate form of this leaf. The leaves are always rigid, and provided at the back with an elevated edge, which runs to the apex of the leaf. The biennial twigs (Plate LX. figs. 1 & 2) are much thicker and also quite covered with leaves, which are scale-like, applied to the stem; they are broader than the leaves of the annual twigs, and closer together at the base of the twigs. They show at different places the scars on which the alternate shoots have been fastened. I only saw one branch with whorled twigs (Plate LIX. fig. 13). The branches of three years (Plate LIX. figs. 9 & 11) are 5 to 6 millims in breadth. We see on them numerous cicatrices of branches, which indicate the insertion of the twigs. The leaves are nearly of the same size as those of the biennial ones; they are, however, not so close together; they are scaly, adhering to the twigs, and the epidermis is provided with many longitudinal wrinkles. These twigs are thicker at the base (Plate LIX. fig. 11). As there are many twigs found thus thicker at the base, they appear to have separated themselves very easily from the stem at the place of insertion. The leaves disappear on still thicker and therefore older twigs, and only small scars remain on the bark. Beside these branches of different ages, there are trunks which probably belonged to this tree.

The cones are solitary or in pairs (Plate LIX. fig. 14, restored fig. 15), on rather slender twigs quite covered with scaly leaves. They are globose (Plate LIX. fig. 16, restored fig. 17; fig. 14), or shortly oval (fig. 19), from 15 to 24 millims. in length, and from 15 to 17 millims. in breadth. The scales are peltate, the footstalk is short, and seems to be central (Plate LX. figs. 29, 30 & 33); the upper side is polygonal, but this form is not constant; in the middle is a very short mucro, from which originate several wrinkles that radiate to the margin; the surface is therefore pretty roughly wrinkled. Cones in which the scales are closed are rare (Plate LIX. figs. 14, 16 & 18). They must have been enveloped by the clay when still fresh. They are often spread open and the scales separated from one another, and the spaces filled with clay (Plate LX. figs. 27 & 28); or we have but solitary scales or portions of cones (Plate LX. figs. 29–35).

There are several seeds beneath every scale (Plate LX. fig. 25); they are also very often scattered between the twigs. The seed is usually 5 millims. long and $3\frac{1}{3}$ millims. broad, and flat; it is somewhat emarginate at the point of insertion, obtusely rounded and a little tapered towards the tip. The nucleus is somewhat curved and pretty flat. It is surrounded by a flat wing (Plate LX. figs. 37–41; fig. 41 *b*, magnified).

In the lignite of Bovey both small and very large pieces of resin are found, which were probably secreted by the *Sequoia Couttsiæ*.

The lignite of Bovey contains very large stems, the zones of which are mostly distinct and crowded; in several stems I could count a hundred of them. One can easily split

them longitudinally; but they become quite hard and brittle in the air, and crumble if cut. They are then brown or black. The microscopical examination did not give me satisfactory results. I certainly recognized the elongated woody fibres, but in most cases I was not able to distinguish the structure of their walls, which is very obscure. However, in some cases I saw pores, which are ranged in one row (cf. Plate LXXI. figs. 8 & 9), and, further, the medullary rays, which are formed from a single row of cells (Plate LXXI. fig. 8). There is no trace of spiral or reticulated vessels. The structure of the medullary rays and of the fibres proves it to be coniferous wood. As *Sequoia Couttsiæ* is the only coniferous tree hitherto found in the lignite-beds of Bovey, and was the commonest tree of that country, it is very probable that most of the wood belonged to it.

B. Monocotyledones.

Order I. GLUMACEÆ, Bartl.

Fam. I. GRAMINEÆ, Juss.

1. PHRAGMITES, Trin.

9. PHRAGMITES ŒNINGENSIS, A. Br.? (Plates LXIV. fig. 1 *d*; LXV. fig. 13 *a*; and LXVIII. fig. 2.)

Phr. foliis latis, multinervosis, nervis interstitialibus tenuissimis.

Heer, Flora Tertiaria Helvet. i. p. 64, pl. 22. fig. 5, pl. 24.

Only some small parts of leaves; the determination is therefore uncertain. We observe very slender secondary nerves between the strong longitudinal nerves. We can count twelve of them, all equally strong, between two longitudinal nerves, while in *Phr. œningensis* the median nerve is always a little stronger. In the same layer (in the 17th bed of Bovey) there are also some indistinct remains of culms, which probably belong to these fragments of leaves; likewise the pieces figured in Plate LXVIII. fig. 2, which all represent horizontal sections of culms. Fig. 2 *a* represents the section of a a knot, where, as in *Phragmites communis*, we have a middle part, which appears as a circular umbo, and around it the wall of the culm.

2. POACITES, Br.

10. POACITES, sp. (Plate LXVIII. fig. 3.)

Bovey (Dr. Falconer).

It is a thin, finely striated grass-culm, on which we perceive a knot. It is $2\frac{3}{10}$ millims. in breadth. It is not sufficient for a more exact determination, but seems to prove that small grasses existed in that country.

Fam. II. Cyperaceæ, DC.

3. Cyperites, Hr.

11. Cyperites deperditus, m. (Plate LX. fig. 54.)

C. fructibus parvulis, ovatis, apice acuminatis, tenuissime striolatis.

In the 26th bed of Bovey; fragments only.

Under the name of *Cyperites*, I have comprised in my 'Flora Tertiaria' those remains (leaves, culms, and fruits) belonging to plants of the family of the Cyperaceæ which it is not possible now to refer to any genus. The fruits in question very much resemble those of *Carex*, and belong probably to this genus. They are like those of *Carex recognita*, Hr., from Rochette. The fruit is 4 millims. in length, and at the base $2\frac{2}{5}$ millims. in breadth; it is there obtusely rounded, but tapered and acuminate at the apex. It is provided with very fine longitudinal striæ.

Order II. PRINCIPES, Linn.

(Palmæ.)

1. Palmacites, Hr.

12. Palmacites Dæmonorops. (Plates LXII., LV. figs. 7–15.)

P. spatha coriacea, longitudinaliter tenuissime striata granulataque, aculeata, aculeis crebris seriatim in lineis oblique transversis conjunctis, compressis, subulatis, rectis, simplicibus, binis, trinis, vel ad summum senis, adpressis; caudice gracili, aculeato, fasciculis vasorum rigidis, interne planis vel sulco exaratis.

Palæospathe Dæmonorops, Unger, Sylloge Plantar. Fossil. p. 9, pl. 2. figs. 9–12.

Chamærops teutonica, Ludwig, in Meyer's Palæontogr. viii. p. 86, pl. 20. figs. 2 & 3.

Pretty common in the clay of the 26th bed of Bovey.

Chiefly the prickles are found at Bovey. They are black as coal, brilliant, very thin, and taper to a fine point. Their length varies from 4 to 50 millims. The longest are only 3 millims. in breadth at the base (cf. Plate LV. fig. 13). They are flat, and provided with a very shallow longitudinal depression (Plate LXII. fig. 9 *b*, a specimen highly magnified), which in some cases becomes almost a furrow. There are mostly three of them together (Plates LXII. fig. 1, and LV. figs. 11 & 15), and the median one is the longest (Plate LXII. figs. 2, 10 & 11, magnified). Sometimes there are but two together, or they are single; or, on the contrary, there are four, five (Plate LXII. fig. 3), or more prickles forming a group. In many pieces I am persuaded that they are not fastened on the margin of an organ, but pretty regularly distributed on a plane surface. Therefore they cannot be simple prickles of the petioles of leaves, as of *Chamærops*, for which Ludwig has wrongly taken them, as I was convinced on looking at the pieces represented in Plate LXII. fig. 1, and still more when I washed them in water. We see then that the bundles of prickles are fastened on and pressed against a very finely

striated plane surface, which is provided with minute warts (Plates LXII. fig. 7, and LV. figs. 11 & 12). They are broader at the base. The form of these prickles, their position (mostly three together, and the median of them the longest), and their direction (all are directed forwards and pressed against the surface) agree so well with the organs represented by UNGER from Laubach in the Wetterau, and by LUDWIG from Salzhausen and Hessenbrucken, that we may be persuaded of their belonging to the same plant. UNGER compares these prickles with those which appear on the spatha of *Dæmonorops*. We have indeed in *D. polyacantha*, Martius (Palmæ, pl. 160), and *D. melanochætes*, Blume (Martius, pls. 117 & 125), very similar flat prickles, which are broader at the base. There are often three together, the median one of which is also the longest. As at Bovey, these bundles of prickles are often fastened on a flat, spreading, finely striated organ, which is several millims. in thickness, which may be easily taken for a spatha. But it is quite unsuitable to found the name of the genus upon this spatha, and to describe this plant as *Palæospathe*, for we find the same prickles also attached to the stems. I have found at Bovey, in the 26th bed, the stem of a palm, on which such a bundle of prickles was attached. Unhappily it was ruined on the journey. On the contrary, several of these stems, which I collected in the same layer containing the prickles, have remained entire. Some of them are represented in Plate LV. figs. 7–10. They are from 15 to 17 millims. in thickness, and consist of a bundle of fibres which are converted into coal, and appear like brilliant coal-black threads. Each fibre (or bundle of vessels) is flat on the inner side, which is turned towards the centre of the stem, or furrowed longitudinally; on the outer side it is convex; it represents, therefore, on a transverse section, more or less, a half circle or a crescent. These fibres are in some pieces close together, and in others further apart; the latter are probably from the middle, and the former from the periphery of the stem. Some of the fibres attain a thickness of 1 millim., but many are much thinner. In many pieces these bundles of vessels form a stem (cf. figs. 8 & 9). Sometimes they are free, and appear like long black fibres scattered in the clay; or beside the united ones we see numerous scattered bundles (cf. Plate LV. figs. 7 & 10). These organs very much resemble the bundles of vessels which appear in the lignite of Käpfnach (*Palmacites helveticus*, Flora Tertiaria Helvetiæ, p. 94, pl. 40. fig. 1); but such thick pieces have not hitherto been found at Bovey. The stems were thin, and probably the petioles may have been so too. The construction of the bundles of vessels shows indeed that they belonged to a monocotyledonous plant, and confirms the conclusion derived from the prickles attached to the spatha.

I found at the same place several fragments of leaves (Plate LXVIII. fig. 1) which certainly belong to a monocotyledonous plant, and perhaps, therefore, to the species in question. They are broad portions of leaves, with numerous fine longitudinal parallel striæ of equal strength; nine of them occupy 1 millim. They are therefore very close.

Mr. PENGELLY found a fruit at Bovey* which probably belongs to the plant in ques-

* I have seen only a drawing of this.

tion. It is oval (cf. Plate LX. fig. 50; magnified, figs. 51–53), 13 millims. in length and 10 millims. in breadth, and covered with scales. It resembles the fruit of the Rotang palm; and as the prickles and the construction of the stems point to these palms, we may combine these organs, and conclude that this palm grew at Bovey. In connexion with this I may mention that large pinnatifid leaves (cf. Flora Tertiaria Helvetiæ, iii. pl. 149), which belong to a Rotang palm, have been found at Oeningen. I have described them as *Calamopsis*. The palm of Bovey belongs perhaps to this genus; but I thought it better to place it in the collective genus *Palmacites*, which contains the different organs of palms which cannot yet be ranged in a fixed genus. These prickles have not been found at Oeningen up to the present time; and the petioles of *Calamopsis* are without prickles. Similar black prickles, however, appear in different genera of palms (for instance *Bactris*), but they are certainly most frequent in the group of the *Calameæ*, Kunth (*Lepidocaryinæ*, Mart.).

C. Dicotyledones.

Coh. I. *APETALÆ*.

Order I. AMENTACEÆ.

Fam. I. CUPULIFERÆ, Rich.

1. QUERCUS, Linn.

13. QUERCUS LYELLI, m. (Plates LXIII. figs. 2–9; LXIV. figs. 1–4; LXV. fig. 12 *b*; LXVI. figs. 1 & 2; LXVIII. figs. 4 & 5.)

Q. foliis subcoriaceis, petiolatis, lanceolatis vel oblongo-lanceolatis, basi attenuatis, margine undulatis, apice acuminatis, nervo primario valido, recto, nervis secundariis numerosis, curvatis, apice furcatis, ramulo superiore margini valde approximato.

Phyllites cuspidatus, Rossmässler, Beiträge zur Versteinerungskunde, p. 36, pl. 9. figs. 38 & 39.

It frequently appears in the 17th bed at Bovey.

Three forms are distinguishable:—1. narrow lanceolate leaves, which are strongly tapered at the base, and the margin of which is slightly undulated (Plates LXIV. fig. 1 *b*, *c*; LXIII. figs. 3 & 8); 2. narrow leaves, with almost parallel sides in the middle (Plate LXV. fig. 12 *b*); 3. broad leaves, which are distinctly undulated at the margin (Plate LXVI. figs. 1 *a* & 2; LXIII. figs. 5–7). This last form is the most frequent, and is to be considered as the typical. These leaves are of a pretty hard texture, but they seem to have been less leathery than those of *Q. furvinervis*. There are no entire leaves preserved; however, with the aid of the different pieces we can complete one. They were broadest in the middle, and gradually tapered towards the petiole and apex. In most of the fragments the petiole is not preserved. The piece represented in Plate

LXIII. fig. 9 shows us a petiole 14 millims. in length, in which it differs from *Q. furvinervis*. The pieces represented in Plate LXVIII. figs. 4 & 5 show us that the apex of the leaf was very long. The piece represented in fig. 5 had a very tapered apex. The broad leaves have a pretty strongly undulated margin (Plates LXIV. fig. 1 *a*, and LXIII. fig. 7, magnified 7 *b*) without forming teeth. The median nerve is strong and straight. Numerous secondary nerves spring from it at an angle of 50°. They are rather strongly curved, and reach nearly to the margin, where they fork, and the upper branch bends forward and, running parallel with the margin to the next following secondary nerve, joins it. The lower branch of the fork is very small and slender, or quite wanting in slightly undulated leaves, and at the places where the undulation is wanting. This course of the secondary nerves is very characteristic of our species, as of *Q. furvinervis* and *Q. undulata*. The areas are divided into secondary areas by continuous, sometimes forking nervules. A polygonal reticulation may be perceived in them, which encloses a still more delicate one (cf. Plate LXIII. fig. 7 *b*).

Rossmässler has described two forms of leaves from Altsattel as *Phyllites furvinervis* and *Ph. cuspidatus*. The latter differs from the former in the undulated margin (which is not toothed), and the long tapering point. As I also got from Weissenfels the toothed form with an elongated point, I formerly united *Ph. cuspidatus* with *Ph. furvinervis* (cf. Beiträge zur nähern Kenntniss der sächsisch-thüring. Braunkohlen-flora, von O. Heer; Abhandlungen des naturw. Vereins für die Provinz Sachsen und Thüringen, ii. p. 424), and I described the form with the narrow leaves as *Q. furvinervis cuspidata*. But as at Bovey there is found only the form with the undulated leaves, and as there is a petiole (which is not preserved with the leaves of Altsattel) which by its length gives us a new distinctive character for *Phyllites cuspidatus*, I have separated it from *Ph. furvinervis*. The name given by Rossmässler could not be retained, as there is already a *Quercus cuspidata*, Thunb. The principal distinction between *Q. Lyelli* and *Q. furvinervis* consists in the length of the petiole, and in the latter species having undulated leaves.

Further examination, and a comparison of more copious material, will show if these differences are specific or not. They belong, at all events, to the same type, which was very frequent in the Lower Miocene period, and of which similar species are still living in Mexico (for instance, *Q. xalapensis*, Thunb.). *Quercus undulata*, O. Weber* (Palæontograph. ii. p. 170, pl. 19. figs. 1, 2 *a* & *b*), is also a very similar species. In the undulated margin, and the manner in which the secondary nerves run, it is like *Q. Lyelli*; but the median nerve of this species is straight and much stronger, not undulated; the secondary nerves are more numerous, and spring at less acute angles.

I still doubt if the leaf represented in Plate LXIII. fig. 7 belongs to the species in

* The leaves (pl. 19. fig. 2 *a* & *b*) in Weber's 'Abhandlung' belong, according to my opinion, also to *Quercus undulata*, and are different from *Q. Gœpperti* (pl. 19. fig. 2 *c*), in which the leaf is rounded at the base. I may mention that the leaf which Ludwig (Palæontogr. viii. pl. 34. figs. 1–4) has represented as *Q. furvinervis*, belongs to another species.

question. The form and kind of tapering at the base agree, but it has more numerous and more crowded secondary nerves.

I found in the 26th bed at Bovey several fragments of bark which probably belonged to an oak, and therefore might belong to the species in question. The bark is very thick and corky, provided with deep longitudinal furrows, and in some places furrowed transversely (cf. Plate LXVIII. fig. 6).

Fam. II. Moreæ, Endl.

2. Ficus, Tournef.

I have already mentioned in my 'Flora Tertiaria' (ii. p. 64) that the leaves of many living species of fig-trees (I allude to the species which have leaves similarly shaped to *Ficus fulva*, Spr., *F. rubra*, Spach, *F. ferruginea*, Desf., and *F. phytolaccæfolia*, Hort. Berol.) have a granulated appearance and a rough surface due to numerous little warts which cover the epidermis, and that the tertiary flora of Switzerland also possessed two species, the leaves of which had the same rough surface. It is very curious that there are in the 26th bed at Bovey leaves which are granulated in this manner; and one of them is very near to *Ficus scabriuscula*, Hr. I therefore believe that I am not mistaken in ranging these three species under the genus *Ficus*. The following facts indicate that the granulation belongs to the leaf and not to the stone:—1. The stone certainly is finely granulated; but these granules are larger than the small points of the leaves, which can only be seen with the aid of a lens, and which are all of the same size; 2. they are regularly spread over the surface of the leaf; 3. they are on all the pieces of this species, but not on the leaves of other plants (e. g. *Cinnamomum lanceolatum*, *Daphnogene Ungeri*, and *Lastræa Bunburii*), which are lying in the same clay.

14. Ficus Falconeri, m. (Plates LXIII. fig. 1 *a*; LXIV. figs. 6 & 7; LXVI. fig. 4.)

F. foliis coriaceis, magnis, confertissime granulatis, elliptico-lanceolatis, apice longe acuminatis, nervis secundariis subtilissimis, remotis, valde curvatis.

The leaf represented in Plate LXIV. fig. 7 is the best preserved. The upper part is quite perfect, but the base is wanting. It is entire, and 12 millims. wide in the middle; it is gradually tapered towards the apex, forming a long narrow point. The secondary nerves are very delicate, and there are but few to be discovered with the lens. They are strongly curved, and form arches, which are far from the margin. The areas are divided by very delicate nervules, and filled up with a very delicate reticulation. The rigid points which cover the whole surface are very small, and only to be seen with a strong lens. Plate LXIV. fig. 6 is the point of the leaf, the secondary nerves of which are more distinct.

It is still doubtful if the leaf represented in Plate LXIII. fig. 1 *a* belongs to this species. It shows the same peculiar sculpture (cf. fig. 1 *a a*), and also very delicate secondary nerves; but they approach nearer to the margin, and are much less directed

towards the apex. This leaf is very like *Ficus obtusata*, Heer*, and belongs perhaps rather to this species; but as the specimen is incomplete, it is better to unite it with *Ficus Falconeri*. It may be that the areoles of the small areas are not so long (cf. fig. 1 *a a* magnified, and 1 *a a a* still more magnified) as those of *Ficus obtusata*. They are quite covered with little warts. The secondary nerves of the leaf in question are also very delicate, and united in strongly curved arches at the end. The areas are divided by means of delicate nervules into secondary areas, in which is the fine polygonal reticulation (fig. 1 *a a*).

15. Ficus Pengellii, m. (Plates LXV. figs. 7 & 8, and LXVI. fig. 3.)

F. foliis coriaceis, longe petiolatis, confertissime granulatis, ellipticis, basi apiceque attenuatis, nervis secundariis remotis, angulo acuto egredientibus, valde curvatis.

The leaf represented in fig. 8 shows the same peculiar sculpture as the former species (cf. fig. 8 *b*, where the portion of a leaf is magnified); it is more indistinct in the second leaf (fig. 7), which belongs to the same species. The species in question differs from the former one in the elliptical form of the leaf, which has no long point, and the acute angle of the secondary nerves. The leaf is broadest in the middle and equally tapered at both ends, so that the sides form pretty regular curved lines. The secondary nerves are delicate, springing from acute angles, strongly bent towards the apex, and thus form long arches. The principal areas are divided by means of delicate nervules into secondary areas, in which the polygonal areas are covered with very small rigid points that are only to be seen with the aid of a strong lens. The petiole is very long, and rather slender. It belongs to the same section as *Ficus phytolaccæfolia*, Hort. Berol.

16. Ficus eucalyptoides, m. (Plate LXV. figs. 3, 4 & 5.)

F. foliis coriaceis, lanceolatis, confertissime granulatis, basi apiceque attenuatis, nervis secundariis subtilissimis, valde curvatis.

This is another hard leathery shining leaf, but much smaller than that of the former species. It is broadest in the middle, and almost equally tapered towards both ends. It is doubtful if a petiole existed. Very delicate secondary nerves spring from the median nerve; they are jointed in strong arches. The surface is also covered with very delicate warts. It is like the leaf of *Eucalyptus oceanica*, Ung., in form, but differs especially in the surface, because *Eucalyptus* has quite a smooth leaf.

* Flora Tertiaria, ii. p. 65, pl. 82. figs. 5 & 6, pl. 100. fig. 14.

Order II. PROTEINÆ.

Fam. I. LAURINEÆ, Vent.

1. LAURUS, Linn.

17. LAURUS PRIMIGENIA, Ung. (Plate LXV. fig. 6.)

L. foliis subcoriaceis, late lanceolatis, acuminatis, nervo primario valido, nervis secundariis tenuibus, sparsis, sub angulo acuto egredientibus.

Unger, Fossile Flora von Sotzka, p. 38, pl. 19. figs. 1–4.

Heer, Flora Tertiaria Helvetiæ, ii. p. 77, pl. 89. fig. 15; iii. p. 184, pl. 153. fig. 3.

In the 26th bed.

The leaf represented in Plate LXV. fig. 6 agrees very well with the leaf of the Hohe Rhonen, which is represented in pl. 153 in my 'Flora.' It is dark brown, rather hard, smooth and entire, and gradually tapered towards the base. The secondary nerves are at a distance from each other, strongly curved, and form long arches near the margin. The large principal areas are divided into secondary areas by fine nervules. The apex of the leaf is not preserved.

2. CINNAMOMUM, Burm.

18. CINNAMOMUM ROSSMÄSSLERI. (Plate LXVII. figs. 17 & 18.)

C. foliis ellipticis vel oblongo-ellipticis, triplinerviis, nervis lateralibus acrodromis apicem attingentibus, nervatione in areis reticulata.

Flora Tertiaria Helvetiæ, ii. p. 84, pl. 93. figs. 15–17.

Phyllites cinnamomum, Rossmässler, Versteinerungen von Altsattel, p. 23, taf. 1. fig. 4.

Daphnogene cinnamomifolia, Unger, Genera et Spec. Plant. Foss. p. 424.

Bovey Tracey, in the 17th bed.

The two fragments figured are the only ones which were found; their apices are wanting, the determination therefore cannot be considered as quite sure. The leaf, however, agrees in its size, form, and nervation with *C. Rossmässleri*. Only a little piece is wanting in the leaf represented in fig. 18, as the raised sides show; the two lateral nerves run, however, to the end of the preserved part, and are so distinct there that undoubtedly they reached to the apex, which forms the principal character of the leaf, which is nearly related to *C. zeylanicum*, Bl., and still more to *C. eucalyptoides*, Nees (*C. nitidum*, Hook.). The leaf has a tolerably slender petiole; it is broadest in the middle, and equally tapered towards both ends. The two lateral nerves springing above the base are pretty strong, and run parallel with the margin. The very delicate nervules spring at right or at least not very acute angles.

19. CINNAMOMUM SCHEUCHZERI. (Plates LXVII. figs. 9–16; LV. fig. 4 *e*; LXVIII. fig. 12.)

C. foliis petiolatis, ellipticis, ovalibus et oblongis, triplinerviis, nervis lateralibus margine parallelis vel subparallelis, apicem non attingentibus; pedunculis articulatis, pedicellis apice incrassatis, fructibus ovatis.

Flora Tertiaria Helvetiæ, ii. p. 85, pl. 91. figs. 4–24, pl. 92, pl. 93. figs. 1–5.

Rather frequent in the 17th and 26th beds at Bovey.

These are leathery, entire, and three-nerved leaves, which are broadest in the middle, and gradually and equally tapered towards both ends; they are acuminated at the base in the same manner as at the apex, without running into the petiole; the sides form almost regularly curved lines. The two strong lateral nerves are jointed above the base of the leaf; they are mostly opposite (Plate LXVII. figs. 11, 13 & 16), the one seldom a little higher than the other (Plate LXVII. figs. 10 & 15); they run parallel with the margin. They do not reach to the apex of the leaf, but they unite above the middle of the leaf with a secondary nerve of the midrib (figs. 10 & 11). The areas are provided with very delicate nervules, which spring at almost right angles. I found the two flowers which are represented in Plate LXVIII. figs. 13 & 13 *c* (magnified 13 *b* and 13 *d*) in the 26th bed of Bovey. They very much resemble the flower from Oeningen represented in the 'Flora Tertiaria Helvetiæ,' pl. 91. fig. 23 *b*, and therefore probably belong to *Cinnamomum Scheuchzeri*. The leaflets of the perianthium of the flower represented in fig. 13 *c* are indistinct; they are much better preserved in fig. 13 (magnified 13 *b*). There are six leaflets, standing in two whorls around a circular wall. The leaflets are hard, shortly oval, obtusely rounded at the apex, and provided with longitudinal striæ. They are shorter and broader, and more obtusely rounded than in *Cinnamomum polymorphum*, A. Br. (cf. Flora Tertiaria Helvetiæ, pl. 94. figs. 1–5). We have beautiful branches from Oeningen with leaves of this species. We lately got a branch with the inflorescence, which confirms the systematic position which I assigned to the leaves. I therefore represent this branch in Plate LXVII. fig. 12. Numerous flowers, still in the state of buds, but nearly breaking off, are lying together, and sometimes one above the other, so that it is not possible to find out their insertion with certainty. One sees, however, that the peduncles spring from the axils of the leaves, and we have therefore an axillary inflorescence. The peduncles are club-shaped above, and this part forms with the bud an almost globose body, on which the leaflets of the perianthium are indicated at some places. These peduncles lengthen afterwards and become more sharply articulated, as the peduncles and fruit-stalks which I have represented in my 'Flora Tertiaria' (pl. 91. figs. 4–7) show.

It is very like *C. pedunculatum*, Thb., from Japan.

20. CINNAMOMUM LANCEOLATUM. (Plates LXVII. figs. 1–8; LXVIII. figs. 14 & 15.)

C. foliis petiolatis, lanceolatis, basi apiceque acuminatis, triplinerviis, nervis lateralibus margine parallelis, approximatis, acrodromis, apicem non attingentibus.

Flora Tertiaria Helvetiæ, ii. p. 86, pl. 93. figs. 6–11.

Daphnogene lanceolata, Unger, Fossile Flora von Sotzka, p. 37.

Rather common in the 17th and 26th beds; it is also a leaf of the 54th bed.

Is like *C. Scheuchzeri*, but differs from it in the leaves being narrower, longer, elongated into a long point, and tapering towards the petiole.

The leaf is also leathery, strongly tapered towards the base, and gradually towards the apex, forming a long sharp point. The two strong lateral nerves are near the margin and run parallel with it; delicate secondary nerves proceed from the median nerve above the middle of the leaf and join them; several delicate secondary nerves follow more outwards. The areas are traversed with very fine nervules, and the secondary areas which these form are filled up with a fine polygonal reticulation. The nervules spring at almost right angles, and the upper secondary nerves at acute angles. Fig. 1 represents a leaf of the 26th bed, the others are of the 17th; figs. 5 & 6 represent young leaves.

3. Daphnogene, Ung.

21. Daphnogene Ungeri, Hr. (Plate LXV. figs. 1 & 2.)

D. foliis lanceolatis, basi subrotundatis, longe petiolatis, triplinerviis, nervis basilaribus margine subparallelis, nervulis obsoletis.

Flora Tertiaria Helvetiæ, ii. p. 92, pl. 96. figs. 9–13.

Ceanothus lanceolatus, Ung., Fossile Flora von Sotzka, p. 49.

Bovey, in the 26th bed.

This leaf differs from those of *Cinnamomum Scheuchzeri* and *C. lanceolatum* in being widest below the middle, and in the delicate nervules being absent in the large areas. In most of the leaves of this species from our molasse, and also from Manosque in Provence, the base of the leaf is rounded, which is not the case in the Bovey leaves; but since also at Sotzka (cf. Unger, plate 31. fig. 14) leaves occur of which the base is not so much rounded off, we may without hesitation unite the Bovey leaves with the above-mentioned species. The leaf (fig. 2) otherwise agrees very well with that which is represented by Unger.

The leaves are hard, coriaceous; they attain the greatest breadth below the middle, and taper gradually to the apex. The strong lateral nerves run near the margin and parallel with it; they have no visible nervules in the areas.

Fam. II. Proteaceæ, R. Br.

4. Dryandroides, Ung.

22. Dryandroides hakeæfolia, Ung. (Plate LXV. fig. 12 *a*.)

Dr. foliis coriaceis, firmis, lanceolatis lineari-lanceolatisque, in petiolum attenuatis, apice acuminatis, plerumque apice dentatis, dentibus remotis, inæqualibus, nervo medio valido, nervis secundariis subtilissimis, camptodromis, areis marginem fere attingentibus, nervatura firma, hypodroma, areolis magnis scrobiculatis.

Unger, Fossile Flora von Sotzka, p. 39, pl. 20. figs. 7–10.

Heer, Flora Tertiaria Helvetiæ, ii. p. 100, pl. 98. figs. 1–13, plate 99. figs. 4–8.

Only fragmentary leaves have been found at Bovey (in the 17th bed), but they cannot be mistaken, since they have the characteristic nervation of this species. In one piece (which in fig. 12 *a* lies upon the slab with the apex pointing downwards) part of the margin is still complete, and shows the sharply indented teeth which *Dr. hakeæfolia* commonly has. In the same leaf the nervation is pretty well preserved. The secondary nerves are very delicate, and project but very little beyond the other reticulation. To the naked eye, or when but slightly magnified, the leaf appears dotted, owing to the distinctly projecting small arches which form the reticulation.

23. Dryandroides lævigata. (Plate LXV. figs. 9, 10 & 11.)

Dr. foliis coriaceis, firmis, lanceolatis, basi in petiolum attenuatis, apice attenuatis plerumque integerrimis, nervo medio valido, nervis secundariis manifestis camptodromis.

Flora Tertiaria Helvetiæ, p. 101, pl. 99. figs. 5–8.

In the 17th bed of Bovey.

It is very like the preceding species; but the margin is generally entire, and the nervation is more delicate, being less prominent.

The leaf of Bovey which has been represented in fig. 10 is coriaceous, lanceolate, and tapering gradually towards the tip, where it ends in a point; it is entire; the median nerve is rather strong, but the secondary nerves are very delicate; they reach to near the margin, where they form arches. The more delicate reticulation, which is formed by very small and densely crowded areoles, can be made out by the aid of a lens, but it is much less distinct than in the foregoing species.

The leaf agrees well with that which has been represented in plate 99. fig. 7 of my 'Flora Tertiaria.'

24. Dryandroides Banksiæfolia. (Plate LXVIII. fig. 7.)

Dr. foliis petiolatis, firmis, linearibus vel lanceolato-linearibus, undique argute serratis, basi apiceque acuminatis, nervis secundariis approximatis, subrectis, simplicibus, parallelis.

Flora Tertiaria Helvetiæ, ii. p. 102.

Myrica Banksiæfolia, Ung., Gen. et Spec. Pl. Fossil. p. 395.

Bovey, in the 26th bed.

Only the portion of a leaf represented in Plate LXVIII. fig. 7 has been found at Bovey. It cannot be determined with certainty, as the characters which the above diagnosis (copied from my 'Flora') contains are not recognizable in them.

It was certainly a hard leathery leaf with a very delicate nervation. The secondary nerves are but slightly indicated and run towards the teeth, which are very sharply cut. The fragment probably represents part of the leaf near the base, like plate 100. fig. 10

of the 'Flora Tertiaria Helvetiæ'; and that is the reason why the teeth are there wanting. We find them, however, in most of the leaves of *D. Banksiæfolia*.

Fam. III. SANTALACEÆ, R. Br.

5. NYSSA, Linn.

25. NYSSA EUROPÆA, Ung. (Plate LXIX. figs. 11–17.)

N. putamine 4½–7 mm. longo, 3–6½ mm. lato, ovali, rarius subgloboso, basi truncato, extus striis longitudinalibus rugosis exarato.

Unger, Sylloge Plantar. Fossil. p. 16, pl. 7. figs. 25–27.

Frequent in the 26th bed of Bovey.

The fruit most probably agrees with the fragments which UNGER described as found at Nidda in the Wetterau, and which I got from Salzhausen; the latter are, however, somewhat more compressed, and consequently more flattened; hence the wrinkled longitudinal ribs do not project so much. Very similar also is a fruit represented as *Nyssa rugosa* by O. WEBER in the 'Palæontographia,' ii. plate 20. fig. 10 *c*; this fruit differs, however, in its shape and smaller dimensions, from two other fruits that were mentioned by WEBER under the same name.

We distinguish amongst the Bovey fruits three forms:—

a. Oval fruits, 4½ to 5½ millims. long and 3 to 4 millims. wide; they are truncated at the base, in the fore part obtusely rounded and marked with numerous rather deeply wrinkled longitudinal furrows (figs. 11–14, magnified 12 *b*).

b. Oval fruits, 6–7 millims. long and 4–5 millims. wide; they are also truncated at the base, but somewhat rounded, marked with numerous wrinkled longitudinal furrows. They are shaped like the stones of *Nyssa sylvatica*, but are somewhat smaller (figs. 15 & 16).

c. Nearly globose fruits, 7 millims. long and 6 to 6½ millims. wide; at the base abruptly truncate, with strongly marked irregular wrinkled furrows (fig. 17, magnified 17 *b*).

The form *a* is the most frequent; the form *c* has been met with in but a few pieces; the form *b* is not rare, and corresponds most to the fruit-stones of the Wetterau. Whether these forms belong to one or more species, I dare not decide.

They are very like the fruit-stones of the species of *Nyssa* which grow at present in the United States, especially of *Nyssa biflora* and *denticulata*, which are represented by GÄRTNER (De Fructibus, iii. p. 216).

26. NYSSA LÆVIGATA, m. (Plate LXIX. fig. 18, magnified 18 *b*).

N. putamine 5–7 mm. longo, 4–5 mm. lato, ovali, basi truncato, lævigato, extus bistriato.

In the same bed of Bovey; rare.

It has the same dimensions and shape as the foregoing species, but it is smooth, shining, and without wrinkled furrows, notwithstanding we observe on the outside two longitudinal lines, which are formed, as in the fruit-stones of *Nyssa*, by delicate striæ.

27. NYSSA MICROSPERMA, m. (Plate LXIX. fig. 24, magnified 24 *b*.)

N. putamine 4 mm. longo, globoso, extus striis longitudinalibus rugosis exarato.

Only a single specimen from the same bed.

It is upon the whole very like the small forms of *Nyssa europœa*, but it is still smaller, perfectly globose, truncated at the base and deeply furrowed.

At the base of the fruit-stone appears a small hole; the sides are marked with deep longitudinal furrows, and the intervening ribs are wrinkled.

28. *Nyssa striolata*, m. (Plate LXIX. figs. 20–23, magnified 20 *b*.)

N. putamine 10–12 mm. longo, 6–8 mm. lato, compresso, ovali, tenuiter longitudinaliter striato.

Several specimens from the 26th bed.

It is very like the *Nyssa ornithobroma*, Ung. It is of the same shape and the same dimensions as the specimen represented by UNGER (fig. 16), from which we must separate it, because the striæ are more delicate and more densely arranged. The small nuts are perfectly flattened, and at the base obtusely rounded, but they terminate in the apex in a small point. Along the middle of each specimen runs a longitudinal fissure, which was probably caused by pressure. The side is furrowed by numerous very delicate longitudinal striæ, while the intervening spaces are smooth.

Coh. II. *GAMOPETALÆ.*

Order I. BICORNES, Endl.

Fam. I. ERICACEÆ, Dec.

1. ANDROMEDA, Linn.

29. ANDROMEDA VACCINIIFOLIA, Ung. (Plate LXVIII. fig. 9.)

A. foliis coriaceis, oblongis, integerrimis, apice obtusis, basi rotundatis vel subrotundatis, petiolatis.

Unger, Fossile Flora von Sotzka, p. 43, pl. 23. figs. 10–12.

Heer, Flora Tertiaria Helvetiæ, iii. p. 7, pl. 101. fig. 25.

In the 17th and 26th beds of Bovey.

I found several pieces, but only the one represented in fig. 6 has remained entire, the others have been ruined on the journey. This leaf certainly agrees with the leaves represented in my 'Flora,' figs. 25 *b* and 25 *c*. The leaf has a petiole and a pretty strong median nerve; the lateral nerves are obsolete, and the reticulation is not preserved.

30. ANDROMEDA RETICULATA, Ett. (Plate LXVIII. figs. 10 & 11.)

A. foliis coriaceis, lineari-lanceolatis, acuminatis, basi in petiolum attenuatis, integerrimis, nervatione dictyodroma.

Ettingshausen, Tertiäre Flora von Haering, p. 65, pl. 22. figs. 9 & 10.

Bovey; several pieces in the 26th bed.

The leaf is hard, leathery, and tapers towards the petiole, narrow-lanceolate, the sides almost parallel; the apex is not preserved in the leaves of Bovey. The median nerve is pretty strong; the whole leaf is covered with a fine polygonal reticulation (fig. 10 *b*, a portion of a leaf magnified), which reaches from the median nerve to the margin and has almost everywhere meshes of the same size. Only at some few places in this reticulation there appear delicate secondary nerves, which rise at a very acute angle. It very well agrees in the form and nervation with pl. 22. fig. 9 of ETTINGSHAUSEN'S work.

This species is nearly related to *Andromeda protogæa*, Ung., and is perhaps a variety of it; the reticulation is, however, much more delicate, and can only be seen with the lens. The leaf of *Eucalyptus oceanica*, Ung., is similarly shaped, but the nervation is different.

Fam. II. VACCINIEÆ, Dec.

2. VACCINIUM, Linn.

31. VACCINIUM ACHERONTICUM, Ung. (Plate LXVIII. fig. 8.)

V. foliis subcoriaceis, ovalibus vel oblongis, integerrimis, petiolatis.

Unger, Flora von Sotzka, p. 43 (ex parte), pl. 24. figs. 1, 3, 4 & 6.

Heer, Flora Tertiaria Helvetiæ, iii. p. 10, pl. 101. fig. 29.

Bovey, in the 26th bed.

A small longitudinal, oval and entire leaflet with a short petiole. The median nerve is thin, and several delicate curved secondary nerves proceed from it.

This leaflet is longer and more tapered at the base than those of the 'Flora Tertiaria Helvetiæ,' but it certainly agrees with the leaf represented by UNGER in the 'Flora of Sotzka,' pl. 26. fig. 6, and may therefore be referred to this species.

Order II. CONTORTÆ, Endl.

Fam. I. APOCYNEÆ, R. Br.

1. ECHITONIUM, Ung.

32. ECHITONIUM CUSPIDATUM, Hr. (Plate LXIV. figs. 3 *b* & 5; Plate LXV. fig. 12 *c*.)

E. foliis lineari-lanceolatis, apice cuspidatis, integerrimis, nervis secundariis numerosis, camptodromis, areis margini approximatis, reticulatis.

Heer, Flora Tertiaria Helvetiæ, iii. p. 192, pl. 154, figs. 4–6.

Several pieces of leaves from the 17th bed of Bovey.

The more delicate nervation is almost obliterated in the fragments of the leaves from Bovey, but these agree well with our species as to their forms and the direction of the secondary nerves; nevertheless this determination cannot be considered to be quite certain. Very similar is a leaf from the lignite of the Rhine, which is represented by O. WEBER as *Labatia salicites* (Palæontogr. iv. p. 154, pl. 28. fig. 1); but the leaves of Bovey, like those of Locle, taper into a more elongated apex, and the arches of the secondary nerves approach nearer the margin.

The leaf is very long and narrow, tapering gradually towards the base; and also elongating into a very long point. From the median nerve spring rather numerous secondary nerves, which are highly incurved, forming near the margin arches that run nearly parallel with the latter; these arches are very delicate, and can only be traced by the aid of a lens. The reticulation of the areas is only slightly indicated.

Order III. RUBIACINÆ.

Fam. I. RUBIACEÆ, Juss.

1. GARDENIA, Ell.

33. GARDENIA WETZLERI, Hr. (Plate LXIX. figs. 1–8.)

G. fructibus lignosis, oblongo-ovalibus vel ovato-lanceolatis, subcostatis et multistriatis, polyspermis, seminibus nigro-brunneis, nitidis, striis spiralibus notatis.

Heer, Flora Tertiaria Helvetiæ, iii. p. 192, pl. 141. figs. 81–103.

Passiflora Braunii, Ludwig, Palæontograph. viii. p. 124, pl. 48. figs. 1, 4, 5 & 16.

Bovey Tracey, in the 34th bed.

At Bovey no complete fruits have been found like those which we know from near Königsberg, from the brown-coal of the Rhön and Wetterau and of Günzburg, but we have got rather numerous seeds, partly still in the position which they held within the fruits (cf. Plate LXIX. figs. 1 & 2). These seeds agree, in respect to their position, their forms, and the peculiar structure of the testa, so entirely with those of the Continent, that no doubt can arise about the question whether they belong to the same plant or not. They are arranged in series, but in such a manner that they partly overlie each other; and in consequence of pressure the shape has been here and there somewhat altered, resulting in more or less deep impressions. Figures 3–5 (magnified) show the principal forms which the seeds of Bovey display. At the apex they taper into a small point, at the base they are somewhat rounded; the colour is a shining brownish black, furrowed by very delicate striæ forming distinct spirals, the deeper striæ alternating with the more delicate (cf. especially the highly magnified piece of a seed, fig. 6).

In order to illustrate this remarkable species, which has such a very wide range, I have represented in fig. 7 a fine fruit that was sent me by Director ALBRECHT of Königsberg out of the clays of Samland; fig. 8 represents a similar fruit from Günzburg, remarkable for its great dimensions.

In the 'Flora' (*l. c.*) I have described this species at full length, and I have tried to show that it belongs to the genus *Gardenia*, while LUDWIG refers it to *Passiflora*. It cannot belong to the latter genus, since *Passiflora* has fleshy fruits on long slender stalks, and seeds which are always distinguished by peculiar little pits ("semina impresso-scrobiculata" is mentioned by ENDLICHER as a characteristic feature of this family). Even the genus *Vareca*, to which LUDWIG refers, has fleshy hexagonal fruits, which are only about half an inch long, and furnished at the base with a small round cup with six

notches; of the seeds each rests in a separate cell: all these are peculiarities which are not met with in the fossil fruit (cf. Gärtner, De Fructib. et Seminib. i. p. 290).

In the 'Flora' I have enlarged upon the reasons why I united these fruits and seeds with *Gardenia*. The *Gardenia lutea*, Fres. and *G. Thunbergii*, L. fil., have also ligneous fruits with a pericarp furrowed by similar longitudinal fibres, and they are also supported on short and thick stalks that pass gradually into the fruit; besides we remark, exactly in the same manner as in the fossil fruit of Königsberg, represented in fig. 7 *b*, the placentæ parietales forming ridges, which project from the inner surface, and which constituted most probably soft membranaceous partitions proceeding towards the interior. The seeds of some Gardenias are arranged in series of which the number varies—in one fruit, known from the Brazils, in four, in others in more series; the number of the placentæ also varies from two to six. Thus we have in *G. Thunbergii* five, in *G. lutea* six, while the seeds lie together in great numbers and are indistinctly arranged in series; they are horizontal; in the fossil fruit they are also horizontal, but generally somewhat obliquely turned towards the bottom, with the point directed towards the base of the fruit. They are arranged in series, which are, however, but very seldom as distinctly marked as is the case in the pieces represented by Ludwig. I thought I could distinguish five series, but Ludwig mentioned six; and if so, we should in these fruits assume three placentæ, to each of which two series of seeds are fixed. Yet in the fruit from Königsberg there seem to exist four placentæ; two are visible in the interior of the one-half of the fruit of which the outside is represented in fig. 7 *b*, and two seem to be on the other half (7 *a*); one, which is very distinct, runs somewhat beyond the middle throughout the fruit, and another seems to have existed on the right side at the edge; this latter, however, is indistinct and uncertain. In fig. 7 *c* I have represented the transverse section; the line marks the place where the fruit was broken into halves: also from Salzhausen I got only fruits which were thus split in the middle into halves. I do not know upon what grounds M. Ludwig supposed that the fruit was divided into three valves. It was certainly an indehiscent fruit.

Coh. III. *POLYPETALÆ.*

Order I. UMBELLIFLORÆ.

Fam. Ampelideæ, Kunth.

1. Vitis, Linn.

34. Vitis Hookeri. (Plate LXIX. figs. 27, 28 & 29.)

V. seminibus parvis, $3\frac{1}{2}$ mm. longis, 3 mm. latis, brevibus, ovato-acuminatis, læviusculis, dorso convexiusculis, tuberculo chalazino rotundato magno.

Bovey Tracey, in the clay of the 26th bed.

I have got but one single seed of this species, which, however, cannot be mistaken. It is very like those of the grape of Salzhausen, which A. Braun described as *Vitis*

teutonica, and of which UNGER (Syllog. Plantarum, p. 23, pl. 9. figs. 1–8) and LUDWIG (Palæontogr. viii. p. 118, pl. 45. figs. 1–5, pl. 46. fig. 6) lately gave descriptions and drawings; it is a species which had a very wide range, and which I pointed out as occurring at Oeningen, in the brown coals of the Rhön and at Schossnitz. The seed of the grape of Bovey is, however, smoother, comparatively wider and shorter; more flattened on the dorsal part, and the little pits on the ventral surface are less deep; while also the small wart (verruca) on the back is somewhat larger, for which reasons we must separate the seed of this grape as a different species.

It is most obtusely rounded at the base, and terminates at the apex in a little short point; upon the dorsal part (fig. 29, six times magnified fig. 29 *d*) it is only slightly convex; the chalazal tubercle (tuberculum chalazinum) is large and nearly circular; upon the ventral part (fig. 29 *b*, *c*) appears a rather prominent ridge, along the middle of which runs, as in *Vitis teutonica*, a delicate longitudinal stria; on each side of the ridge we observe a small pit (scrobicula), which, however, is much less deep than in *Vitis teutonica*.

To this or the following species belong probably the grapes from the 17th bed of Bovey (figs. 27 & 28), which are very like those of *Vitis teutonica*. They are flattened, nearly circular fruits, in the interior of which no grains can be distinguished, as in those from the brown coals of Langenaubach (cf. LUDWIG, *l. c.* p. 120).

Fig. 29 represents the dorsal surface of the seed; fig. 29 *b*, the ventral surface; fig. 29 *c*, *d*, magnified; fig. 29 *c*, section; figs. 27 & 28, grape.

35. *Vitis britannica*, m. (Plate LXIX. figs. 25 & 26.)

V. seminibus parvulis, $5\frac{1}{2}$ mm. longis, 3 mm. latis, ovato-ellipticis, dorso planis, tuberculo chalazino obsoleto.

From the 26th bed of Bovey.

Of this species I got two seeds, which belong probably to *Vitis* or *Cissus*; but the chalazal tubercle is not distinct, and the consequent determination cannot be considered to be quite certain. These seeds are longer and comparatively narrower than those of the foregoing species; on the ventral side we observe the prominent ridge; the pits on both sides are very flat and oblong; the dorsal part is flattened. On one seed (the other is much compressed) we observe an oval tuberculum chalazinum, which appears, however, flat, imperfectly stamped out, and therefore indistinct.

Order II. POLYCARPICÆ, Endl.

Fam. ANONACEÆ, Dun.

1. ANONA, Linn.

36. ANONA (?) DEVONICA, m. (Plate LXX. figs. 1–3.)

A. seminibus ovalibus, 19–21 mm. longis, 12–$14\frac{1}{4}$ mm. latis, compressis, lævisculis.

A good many specimens from the 26th bed of Bovey.

Belongs probably to *Anona altenburgensis*, Ung. (Sylloge Plantar. p. 26, pl. 10. figs. 8–11). The representation agrees pretty well with the seeds of Bovey; but as UNGER in the diagnosis calls the seeds "ovato-oblongis," and since those of Bovey are no wider at the base than at the top, I dare not to unite them with those of Altenburg.

Most of the specimens are 20 to 21 millims. long, widest in the middle, narrowing symmetrically towards both ends, where they are most obtusely rounded. They are flat, the diameter only amounting to $2\frac{1}{2}$ millims.; throughout they are formed of an homogeneous mass of coal, which has obliterated all traces of the contents of the seeds. On the outside they are smooth and rather shining when rubbed; sometimes they appear reticulated by delicate fissures, or furrowed with very fine longitudinal and transverse striæ, which are, however, much obliterated, and can only be perceived by the aid of a lens. In some pieces the middle portion is perfectly flat and slopes towards a rather sharp margin (cf. section, fig. 2 *b*), thus forming a flatly bordered seed like those of *A. paludosa*, Ait.; in others the margin is blunted. In one piece (fig. 3) the middle portion has fallen out, thus producing a broad and deep furrow; this is probably only accidental.

In fig. 1 the seed still lies within the stone, convincing us that it is not surrounded by a shell. The perfectly homogeneous substance of the coal indicates a seed and not a fruit; and since the Anonas (especially the *A. paludosa* and *Asimina triloba*) have quite similar seeds, I agree with the determination of UNGER, although it cannot be denied that it must be considered as somewhat doubtful till other organs shall be discovered.

37. ANONA CYCLOSPERMA, m. (Plate LXX. fig. 4.)

A. seminibus suborbiculatis, 14 mm. longis, 11–12 mm. latis, compressis, rugulosis.

At the same spot; several specimens.

They are very like the preceding, but much smaller, especially much shorter; and as the breadth is nearly the same, they are almost orbicular; a network is constituted by numerous irregular fissures, which cause the outside to be somewhat wrinkled (fig. 4 *b*). Since no intermediate forms occur between this and the foregoing, they seem to belong to different species.

Order III. HYDROPELTIDEÆ.

Fam. NYMPHÆACEÆ, Salisb.

1. NYMPHÆA, Linn.

38. NYMPHÆA DORIS, m. (Plate LXX. figs. 32–37.)

N. seminibus ovalibus, $2\frac{1}{2}$–$3\frac{1}{2}$ mm. longis, subtilissime crenulato-striolatis, apice poro perforatis.

From the 54th bed.

Tolerably numerous flattened seeds lying close together: they are oval, $2\frac{1}{2}$ to $3\frac{1}{2}$ millims.

long and 2 to 3 millims. wide; at both ends they are obtusely rounded, and at one end are furnished with a small round hole (fig. 33, magnified fig. 34; fig. 35, magnified fig. 36), which is only visible in those specimens that are compressed from above. The sides are furrowed by very delicate and elegant longitudinal striæ, formed by the cells, which are arranged in lines. They are neatly crenated and very delicately dotted (cf. fig. 37, a highly magnified piece, of which only part of the testa has been preserved). This elegant sculpture can only be made out by the aid of a lens or microscope.

They are very much like the seeds of *Nymphæa alba*, especially the form with the larger seeds, the *Nymphæa alba melocarpa*, Casp. In the recent seeds the longitudinal striæ appear much less distinct; but in such seeds as are found in the 'Pfahlbauten' of Robenhausen, they look exactly like those of the fossil species. In these also the hole on the top of the seed is somewhat more widened, as in the fossil species. As to the shape, the latter differs in so far as the seeds are comparatively somewhat wider (those of *N. alba melocarpa* are $3\frac{1}{2}$ millims. long and 2 millims. wide): this more considerable breadth may have been caused by pressure, since they are all highly compressed. To the same circumstance we may ascribe the fact that the raphe cannot be pointed out distinctly.

The seeds of Bovey are very like those of my *Nymphæa Charpentieri* (Flora Tertiaria, iii. p. 195, pl. 155. fig. 20 *b*, *c*), the latter being only somewhat narrower. It would therefore be very desirable that the leaves be sought for at Bovey, since from these alone can it be decided with certainty whether this species is really distinct from *N. Charpentieri*, to which it comes very near. The seeds of the living *Nymphææ* are variable in their dimensions.

Order IV. MYRTIFLORÆ.

Fam. Myrtaceæ, R. Br.

1. Eucalyptus, Hérit.

39. Eucalyptus oceanica, Ung.? (Plate LXIX. figs. 9 & 10.)

E. foliis coriaceis, 2–5-pollicaribus, lanceolatis vel lineari-lanceolatis, acuminatis, subfalcatis, in petiolum attenuatis, integerrimis, petiolis semipollicaribus, sæpius contortis, nervo primario distincto, secundariis subtilissimis.

Unger, Flora von Sotzka, p. 58, pl. 36. figs. 1–13.

Heer, Flora Tertiaria Helvetiæ, iii. p. 34, pl. 108. fig 21, pl. 154. figs. 14 & 15.

In the clay of the 26th bed.

As at Bovey only fragments of leaves have been found, no sure determination can be given. The leaves are smooth, shining, coriaceous, somewhat incurved, and taper towards the tip. The secondary nerves are very delicate and form arches, which run nearly parallel with the margin. Close by the leaf (represented in fig. 9) lies the top of a leaf of a quite different plant, which seems to belong to *Quercus Lyelli*.

2. Eugenia, Mich.

40. Eugenia Hæringiana, Ung. (Plate LXVIII. figs. 16, 17 & 18.)

E. foliis coriaceis, lanceolato-linearibus, in petiolum brevem crassumque attenuatis, integerrimis, nervis secundariis distantibus, simplicissimis, camptodromis, duobus inferioribus valde elongatis.

Unger, Flora von Sotzka, p. 52, pl. 35. fig. 19.

Heer, Flora Tertiaria Helvetiæ, p. 34, pl. 2. fig. 1, pl. 108. fig. 16, pl. 154. fig. 13.

Bovey, in the 26th bed.

The leaves of Bovey are very like the leaf of Ralligen represented in my 'Flora,' pl. 108. fig. 16. They are leathery, entire, long and narrow, and tapered towards the petiole, the sides being almost parallel. The two long secondary nerves are very near the margin, and run nearly parallel with it. We cannot distinguish the finer nervation.

Resembles *Cinnamomum lanceolatum*, but the leaf is longer, relatively narrower, and has parallel sides.

Order V. FRANGULACEÆ.

Fam. Celastrineæ, R. Br.

1. Celastrus, Linn.

41. Celastrus pseudo-ilex, Ett. (Plate LXVIII. fig. 19.)

C. foliis coriaceis, lanceolato-linearibus, sessilibus, integerrimis, nervo medio debili, secundariis camptodromis.

Ettingshausen, Tertiäre Flora von Haering, p. 70, pl. 24. figs. 30–36.

Heer, Flora Tertiaria Helvetiæ, p. 69, pl. 121. fig. 57.

I found several leaflets in the 26th bed of Bovey; unhappily most of them have been ruined in the journey, and only the piece represented in fig. 19 *b* has remained entire. I drew the piece represented in fig. 19 (magnified 19 *b*) on the spot. These are small, stiff, entire and narrow leaflets, obtusely rounded at the apex. Short lateral nerves proceed from the delicate median nerve. It certainly agrees with the leaves of Haering, and those of Locle and Oeningen.

It may be compared to *Celastrus integrifolius*, Thunb., from the Cape.

Order VI. TEREBINTHINEÆ.

Fam. Juglandeæ, DeC.

Pterocarya, Kunth.

42. Pterocarya denticulata? (Plate LXX. fig. 5.)

Pt. foliis pinnatis, foliolis sessilibus, lanceolatis, acuminatis, argute et creberrime serratis, nervis secundariis numerosis.

Heer, Flora Tertiaria Helvetiæ, iii. p. 94, pl. 131. figs. 5–7.

Juglans denticulata, O. Weber, Palæont. p. 211.

Bovey, in the 26th bed.

This species remains still very doubtful, since nothing but the fragments of leaves represented was found at Bovey. The diagnosis has therefore not been made from these fragments, but from the very fine leaves that were found in our molasse; further discoveries alone can prove whether the fragments of leaves found at Bovey belong really to this species.

The leaf of Bovey is very acutely toothed, and the teeth (augmented in fig. 5 *b*) are highly inclined towards the apex. The secondary nerves are delicate, and for the most part perfectly obliterated.

Order VII. LEGUMINOSÆ, Endl.

Fam. PAPILIONACEÆ, Linn., R. Br.

LEGUMINOSITES, Bow., Heer.

43. LEGUMINOSITES AREOLATUS, m. (Plate LXVIII. fig. 20, magnified fig. 20 *b*).

L. foliolis subcoriaceis, integerrimis, ovalibus, basi valde inæquilateris, nervis secundariis subtilissimis, camptodromis, areis argute reticulatis.

Bovey, in the 26th bed.

Is very like *Leguminosites sclerophyllus* (Flora Tert. Helvet. p. 123), but much more delicate, smaller, and with a sharper reticulation. It may belong to *Copaifera*.

A small leaflet, which has unequal sides at the base. The median nerve is curved and delicate. The secondary nerves are very delicate, at a great distance from each other, and jointed in large arches. The areas are filled up with a very delicate, distinctly projecting polygonal reticulation. The areoles are of equal size.

Incertæ Sedis.

CARPOLITHES, Sternb., Heer, Flora Tertiaria Helvetiæ, iii. p. 139.

44. CARPOLITHES WEBSTERI. (Plate LXX. fig. 6, magnified 6 *b*.)

C. fructibus oblongis, subcompressis, utrinque obtusis, supra basim incurvatam paulo constrictis, longitudinaliter rugoso-striatis, rima longitudinali dehiscentibus, monospermis, membrana interna tenera, libera (testa seminis?).

Carpolithes thalictroides, var. *Websteri*, A. Brongniart, Recherches sur les Ossemens Fossiles, par Cuvier, ii. pl. 11. fig. 5; Mémoires du Muséum, p. 317, pl. 14. fig. 6.

Carpolithes Kaltennordheimensis, Flora Tertiaria Helvetiæ, iii. p. 141, pl. 21. fig. 14, pl. 141. figs. 68 & 69.

Folliculites Kaltennordheimensis, Zenker in Leonhard und Bronn's Jahrbuch, 1833, p. 177, pl. 4. figs. 1–7.

Carpolithes minutulus, Sternb. Versuch. i. 4. p. 41.

Folliculites minutulus, Bronn, Lethæa, p. 849, pl. 35. fig. 11.

J. D. Hooker, "On some small Seed-vessels from the Bovey Tracey Coal," Quart. Journ. Geol. Soc. Lond. for Nov. 1855, p. 566, pl. 17.

Unger, Sylloge Plant. Fossil. p. 17, pl. 7. figs. 10–23.

Hippophaë disperma, Ludwig in Palæontogr. viii. p. 112, pl. 43. figs. 14–18 & 20.

Not rare in the 54th bed; very rare in the rhizome-bed.

The fruits of Bovey agree so perfectly with those of Kaltennordheim, of Rochette, &c., that they must be referred to that species. Geologically they are of great importance, as they have such a wide range in the Miocene formation; it is hence the more to be regretted that their systematic position remains still very doubtful, and that it has even not yet been shown whether these small bodies, which can so easily be distinguished by their characteristic form and structure, are fruits or seeds. Most authors (Brongniart, Zenker, Bronn, and Hooker) consider them to be fruits, while Unger (Sylloge, p. 18) declared recently that they must be seeds, referring to the seeds of coniferous trees: as such I considered them formerly, when I described them (though granting the doubts concerning their character) as *Pinus rhabdosperma*. In all those specimens which I had then seen, the peculiar constricted volva was not distinct; but it is also wanting in all the seeds of conifers which I know, as is also the prominent edge and the sculpture. More probably they are comparable with the seeds of *Samyda*, which have such a volva, and which agree besides pretty well in respect to their form; but then we must bear in mind that the organs in question are ligneous, that they are dehiscent by a longitudinal fissure, and that such facts are much against an interpretation as seeds, though in favour of the hypothesis that they might have had the organization of a fruit.

Hooker supposed them to be cryptogamic fruits, although he was not able to point out an analogy amongst the cryptogamic plants. He maintains this view by stating that in the interior of the fruit a delicate sac is frequently found, which he considers to be a sporangium. This interpretation seems to me not quite correct; the sac seems to result from the testa of the seeds. The dotted and the spiral fibrous cells covering the interior of the cavity are much more in favour of a phanerogamic than of a cryptogamic plant; and in respect of the sac remaining in the interior of the cavity, we know exactly the same organization in cherry-stones which have lain for a long time in water or in wet places. I opened a good many cherry-stones from the 'Pfahlbauten' of Robenhausen; in all, without exception, the seed had disappeared (although the shell was left intact), and in its stead a delicate sac remained, which lay close to the interior surface of the stone, and which could easily be removed. A perfect dissolution of the kernel had taken place, and only the testa remained. The organic contents of the seed must hence have become dissolved, and escaped, in a remarkable manner, through both the testa and the putamen, that no traces of them were left in the cavity of the cherry-stone. Only the ligneous cells of the stone and the testa resisted and were preserved. In the same manner, without doubt, we must account for the existence of the sac of *Carpolithes Websteri*. Sometimes an inorganic substance has been deposited in

the place formerly occupied by the seed, and the interior of the cavity of the fruit is then partly filled with it.

Ludwig (*l. c.*) has united these fruits with *Hippophaë*, adopting, without necessity, a new specific name. These fruits do not, however, agree in the least with those of *Hippophaë*, and decidedly cannot be referred to that genus. He believes that great numbers of such fruits were arranged close together upon the boughs, which circumstance probably led him to refer them to *Hippophaë*. But it seems to me doubtful whether those little heaps of fruits which he represented were really fixed on the boughs that lie close by, or whether they lie only accidentally near the boughs. If they are fixed on the boughs, it will be proved that they are phanerogamic fruits and not seeds, while the interpretation as *Hippophaë* is not justified, considering the other contradictory marks.

The *C. Websteri* has been described so frequently and so carefully, that any more detailed description would be superfluous. I refer the reader especially to the very exact description of Hooker (*l. c.*). Investigation with the microscope showed me that the sac in the interior of the fruit is formed by cells with very thin walls and of different lengths (cf. fig. 6 *d*, *c*), as represented by Hooker in fig. 7, and that the pericarpium, on the contrary, is formed by ligneous cells, which partly show a very curious undulating circumscription, and are dotted (fig. 6). They are arranged in series*.

45. Carpolithes scutellatus, m. (Plate LXIX. fig. 30, magnified 30 *b*.)

C. fructibus complanatis, margine acutis, rotundatis, basi truncatis, dorso costulatis.

A few specimens in the 26th bed at Bovey.

It is a perfectly flat fruit (or seed?) with an acute margin (cf. the section of fig. *c*); at the base it is truncated, at the sides much rounded, obtusely rounded above, nearly in the middle somewhat emarginate. From the base originate a few delicate, partly ramified ribs, which reach somewhat above the middle.

It is rather like the fruits of *Panax*, but the middle partition is wanting.

Since I had only one well-preserved fragment at my disposal, I could not cut it open in order to see whether it had one or two furrows. Perhaps it may be a seed, and not a fruit.

46. Carpolithes Boveyanus, m. (Plate LXX. figs. 7–14.)

C. nucula 3–4½ mm. longa, ovata, apice mucronulata, dorso leviter sulcata, monosperma.

Frequent in the 26th bed at Bovey.

* The drawing M. A. Brongniart has given of this species is very imperfect. I did not myself recognize his drawing as belonging to this species; but Dr. Falconer convinced me that it was so. I compared, in the British Museum, the *Carpolithes thalictroides*, var. *Websteri*, Brongn., of the Isle of Wight with the fruit from Bovey and Kaltennordheim, and am assured that they form one species. But the *Carpolithes thalictroides*, Brongn., must be separated from *Carpolithes Websteri*, as the fruit of the former species is cylindrical and acuminated, whilst the fruit of *C. Websteri* is obtusely rounded. Unhappily the place where these specimens of the Isle of Wight were found is not mentioned in the British Museum. The stone is dark, and different from the White Clay of Alum Bay, where plants are lying. Perhaps they are from the Bembridge series. Latterly I have received many seeds of this species from the Hempstead beds of the Isle of Wight.

It occurs of two different dimensions; some are 3 millims. long and $2\frac{1}{2}$ millims. wide; others are 4–$4\frac{1}{2}$ millims. long and $3\frac{1}{2}$ millims. wide. They agree, however, with the exception of the dimensions, so perfectly, that they cannot be separated.

These fruits are short, oval, rounded at the base, and furnished with a small round hole (fig. 7); the portion around the latter is somewhat wrinkled; at the apex it is furnished with a short little point. The sides are rather flat, and over each side runs a flat longitudinal furrow (fig. 8, magnified 8 *b* & 12 *b*). As the seeds lie in the soft clay, they have hardly been much compressed; the longitudinal furrows have therefore probably not been caused by the circumstance that the pericarpium was pressed in along the cavity of the fruit, but probably are characteristic of the fruit. If we open the fruit in a longitudinal section (fig. 9, and magnified 9 *b* & 10, and of the smaller fruits 13 & 14), we perceive an elliptical partition, which contained, doubtless, one seed, of which, however, nothing is preserved. The wall of the pericarpium is relatively very thick; it must therefore have been ligneous. In a few of the smaller fruits there was a longitudinal fissure.

The whole organization shows that we have here fruits, and not seeds. It is very like the fruit of *Potamogeton* (cf. *Potamogeton Eseri*, Heer, Flor. Tertiar. Helvet. i. p. 102, pl. 47. fig. 8); but the shape of the cell of the fruit (loculamentum) differs and makes it doubtful whether it belongs to this genus. In *Potamogeton* the dorsal part of the fruit is generally much more convex than the ventral part, while the apex of the fruit is somewhat incurved.

47. Carpolithes nitens, m. (Plate LXX. figs. 15–23.)

C. fructibus subglobosis, nigro-nitidis, subtilissime et obsolete striolatis, monospermis, basi truncatis, cicatrice orbiculata vel angulata ornatis.

Taxus margaritifera, Ludwig, Palæontograph. viii. p. 73, pl. 60. fig. 19?

Very frequent in the coal of the 46th bed.

Ludwig gives only a short description, which agrees, however, pretty well, but for the expression "a circular plate with a thin margin and a short stalk*," which I do not understand, and the dimensions, since his fruits are 6 millims. long, whilst those of Bovey are only 5 millims. The seeds of *Taxus* display a similar organization of the cicatrix; it is always regularly orbicular or oval; and the delicate longitudinal stripes are also met with; but the walls are much thicker, and the internal cavity is much smaller. Nevertheless I do not know any genus with seeds and fruits which are so similar to those of Bovey as the seeds of *Taxus*. If it really belong to this genus, we should have a thick ligneous testa, and but a small cavity.

These little shining black bodies have nearly the same breadth and height (of 5 millims.), and are therefore nearly orbicular, although they are frequently compressed in different directions. On the fore part of the perfectly preserved specimens we observe a little point or apex; the base is truncate, and in the middle appears a small round hole,

* Dünnrandige und kurzgestielte Kreisfläche.

surrounded by a cicatrix of a dull colour, which is frequently orbicular, but sometimes polygonal. If we cut them open we observe a small cavity, surrounded by a ring of shining black brittle coal (figs. 19 *b*, 20, 21 & 22). Fig. 22 is a magnified transverse section of the middle; fig. 20 (magnified 20 *b*) a similar section, but nearer the top of the fruit, which is not compressed; and fig. 19 (magnified 19 *b*, 21) a section of a compressed fruit. The wall of the fruit measures 1 to $1\frac{1}{2}$ millim.; the cavity has a diameter of about 2 millims. The black shining crust which covers the internal surface is very thin. It is formed by the testa, if the organization belong to a fruit; but if it be the seed of a *Taxus*, or of some tree resembling the latter, then it ought to be considered as the remains of the albumen, while the wall forms the ligneous testa. The cavity is always filled with a whitish-grey clay. As in the *Carpolithes Websteri*, the softer internal parts of the seed were also in this case dissolved, while the cavity became afterwards filled with mineral substance. The crust of coal corresponds to the cuticula of *C. Websteri*.

48. Carpolithes exaratus. (Plate LXX. fig. 27, highly magnified in figs. 24–26.)

C. putamine subgloboso, $3\frac{1}{2}$ mm. longo, nigro, nitido, sulcis rugoso-punctatis exarato.

In the 26th bed at Bovey.

A remarkable little object, which represents, without doubt, the stone of a fruit. It is $3\frac{1}{2}$ millims. long and $3\frac{3}{10}$ millims. wide, being thus nearly orbicular, although it is furnished with a rather blunt apex, which projects but very little, while the lower end is rounded very obtusely. At one place we observe a narrow fissure, which reaches from the apex to somewhat below the middle of the little stone, which is bordered by a narrow margin. It is, without doubt, the place where the raphe passed, and it may therefore be described as the umbilical fissure. The furrows and ribs upon the little stone are very elegant. On the truncated end (fig. 26, highly magnified) we observe a great many parallel furrows and ribs, which run very near one another to the lower termination of the umbilicus, and which pass also opposite the umbilicus across the back of the little stone; the sides too are marked by similar ribs and furrows; but here the first two are distant, and the furrows are therefore wider; the ribs run much more irregularly, forming ramifications, so that the furrows seem to be interrupted by numerous tubercles. The furrows and the ribs are covered besides with innumerable dots. (In fig. 24 *b*, a piece with a few ribs has been represented as seen under a microscope.)

Similar fruit-stones occur in *Celtis*, but we miss the umbilical fissure and the regularity of the furrows. As regards the character, the stone is more like those of *Prunus*, in which we observe on the suture a channel, within which the raphe runs till it passes through a hole below the apex of the stone towards the seeds. On the fossil we find no such small hole resembling a dot, but only the above-mentioned fissure; besides it differs in the very peculiar sculpture, and must therefore belong to another type of plants.

Fig. 27 represents the little stone of the natural size; fig. 24, the same magnified and viewed laterally; fig. 25, the same from the side of the umbilicus; fig. 26, from the base.

49. Carpolithes vinaceus, m. (Plate LXX. figs. 28 & 29, magnified 29, *b*).

C. semine gigantoideo, tenuissime longitudinaliter striolato, medio unisulcato.

Some pieces from the 26th bed.

This has the form and dimensions of the seeds of the grape (*Vitis vinifera*, Linn.), but it does not belong to the genus *Vitis*; the delicate longitudinal striæ, and the absence of the umbilicus within the fissure, are against such an hypothesis. It seems to me to be the seed of a monocotyledonous plant.

The seed is $6\frac{1}{2}$ millims. long, and at the thicker portion 4 millims. wide; at one end it is much thickened and obtusely truncated, towards the other it is much narrowed. It has a brown, rather shining testa, marked by very delicate striæ. In some places where the testa is removed (fig. 29, magnified fig. 29 *b*), the striæ (or rather the casts of the striæ) are more distinctly visible. They form very delicate longitudinal lines, which are here and there united by transverse lines.

50. Carpolithes lividus, m. (Plate LXX. figs. 30 & 31.)

C. follicularis, membranaceus, brunneus, ovatus.

In the 26th bed; several pieces.

A very doubtful species. Small light-brown oval bodies, with a thin membrane. One perfectly preserved specimen (fig. 30) is $4\frac{8}{10}$ millims. long and 4 millims. wide; it is quite flattened; on the dorsal part it is furrowed by transverse wrinkles (fig. 30 *b*), which were, however, produced by shrinking; otherwise it is smooth, shining, and of a yellowish brown; on the other side there is a longitudinal fissure (fig. 30 *c*, magnified), through which probably the seed fell out, leaving the thin membrane of the pericarp. In such a case it would be a small folliculus, with probably but one seed. It is also possible that it may be the testa of a seed, and that the fissure marks the raphe.

II. *Descriptions of the Diluvial Species of Plants.*

1. Salix, Linn.

1. Salix cinerea, Linn. (Plate LXXI. figs. 1 *a*, *b*, 2 & 3.)

S. foliis lanceolato-obovatis, basi angustatis, apice breviter acuminatis, serratis vel subtiliter undulato-serrulatis, rugulosis, nervis secundariis valde camptodromis nervillisque validis.

Several leaves lie upon the soft white clay, which cannot be distinguished from those of *Salix cinerea*, Linn.; they are like the leaves which occur in the tuffs of Cannstadt. The leaves represented on Plate LXXI. fig. 1 *a*, *b*, are distinctly serrated; the leaf *a* with a rather sharp point; the same is seen on the leaf fig. 3, while the larger leaf, which is represented in fig. 2, has only a slightly undulated and indistinctly denticulate margin, as occurs frequently in *Salix cinerea*. The secondary nerves are perfectly like those of *S. cinerea*; they are inclined forwards, and united, forming long arches, which approach the margin. The nervules are strong, and impart to the leaf a rather wrinkled aspect.

From the midrib spring shortened secondary nerves, which are united with each lower secondary nerve, a character peculiar to the leaves of the willows.

2. Salix, spec. (Plate LXXI. figs. 4 & 5.)

S. foliis petiolatis, oblongis, basi rotundatis, integerrimis (?), rugulosis, nervis secundariis valde camptodromis nervillisque validis.

This is doubtless the leaf of a willow, since it has the same characteristic nervation; the base of the leaf is obtusely rounded, and the margin seems to be entire. The specimen represented in fig. 4 has nearly parallel sides, but the base is obtusely rounded; on the margin no teeth are visible. The secondary nerves are also highly inclined towards the apex, and numerous nervules cause the wrinkled appearance of the surface. The small leaf which is represented at fig. 5 belongs undoubtedly to the same species with the foregoing, although the sides are less parallel. It is very like the leaves of *Salix amygdalina*, Linn., which vary very much in shape; but the secondary nerves and the nervules are strong, and the margin seems to be entire.

3. Salix repens, Linn.? (Plate LXXI. figs. 1 *c–h*, 6 & 7 *b*.)

S. foliis breviter petiolatis, ovalibus, oblongis et oblongo-lanceolatis, integerrimis, nervis secundariis valde curvatis.

The most frequent leaf of the white clays. Numerous fragments lie confused in all directions.

Some forms are rather similar to those of *Salix cinerea*, Linn., but the nerves are not nearly so strongly developed: the surface of the leaf is much smoother, and the margin is not dentate.

The dimensions and the form of these leaves are very variable. The length varies from 6 to 45 millims.: some are short, oval, and obtusely rounded at the apex; others (and they are the most numerous) are oblong, and rather obtuse at the apex; whilst others are lanceolate, and have an acuminate apex. There are so many intermediate forms, that these cannot be separated. The midrib is rather slender; from it rise the secondary nerves at a rather acute angle; they are highly curved towards the apex, and near the margin they are united in arches. The areas are divided by very delicate nervules. At some places the shortened secondary nerves, which pass over to the lower secondary nerves, are visible, but in most of the leaves this important mark is not quite distinct.

As to the shape and nervation of the leaves, it seems to me most nearly allied to *Salix repens*, Linn.; but the incurvate apex is wanting, which, however, does not always exist in *S. repens*. *Salix ambigua*, Ehrh., and *S. ambigua*, Sendtner (*S. aurito-myrtilloides*), have very similar leaves.

2. Betula, Linn.

4. Betula nana, Linn. (Plate LXXI. figs. 1 *k* & 7 *a*.)

B. foliis parvulis, orbiculatis, profunde crenatis, nervis secundariis flexuosis, craspedodromis, basalibus approximatis, areis nervulis reticulatis.

Very pretty little leaves, only 9 millims. long, and nearly orbicular. They have simple teeth, which are, however, deep and acute. From the median nerve arise on each side four secondary nerves, of which the two lowest are very much approximated. Each of them runs in a zigzag line, and terminates in a tooth; from the second spring tertiary nerves; and all are united, forming elegant polygonal reticulations, that can be traced upwards to within the teeth (cf. fig. 1 *k k*, where the leaf has been three times magnified). I saw several entire little leaves in an excellent state of preservation; there have been found besides several fragments of the leaves of this species in the white clay.

The nervation indicates the genus *Betula*. Similar forms occur in the young leaves of *Populus alba*; but in these, five primary nerves spring from the base of the leaf; while the nerves of *Betula* are pinnated, but the first ones approach the base, as seen in the fossil leaf; the reticulation also is that of *Betula*. A comparison of the different species of *Betula* leads us to *Betula nana*, Linn. The fossil leaves agree, indeed, in respect of dimensions, shape, dentation, and nervation so entirely with those of the living species, that no difference can be found; the petiole, however, is somewhat thicker than is generally the case with *Betula nana*.

Betula nana, Linn., is a boreal plant, which is at home throughout the whole arctic zone; it is found also here and there on the highland moors in Middle Europe, as, for instance, near Einsiedeln in Switzerland, and in the Jura. In the British islands it is found in Scotland only.

5. Pinus sylvestris, Linn.?

Dr. J. D. Hooker* speaks of a pine-cone which, according to the late Dr. Croker, was found in the upper layers of lignite. Dr. Hooker says that it so closely resembles that of a Scotch fir (*Pinus sylvestris*, Linn.), that it might be referred to this species. I have seen it in the collection of the Geological Society in London, and another specimen in Dr. Croker's collection at Bovey. I am of the same opinion as Dr. Hooker; but these cones look much more modern than the plants of the lignite beds, and they are, I believe, from the diluvial formation of Bovey.

III. *Insects from Bovey.*

During my stay at Bovey I carefully searched for the remains of insects. I found indeed some traces, but they are but fragmentary, and there is only one fragment which can be determined. It is the partly destroyed elytron of a beetle, probably a *Buprestites*, and which I shall describe as *Buprestites Falconeri* (Plate LXVIII. fig. 21, magnified 21 *b*). It was 8 millims. long and 3 millims. wide. The angle of the shoulder is somewhat rounded, and beneath it the elytron is somewhat curved inwards. It is remarkably sculptured; with the aid of a lens we can perceive numerous round points, which are ranged in rows, and so close together that the whole elytron gets quite a *sculptura alutacea*. The species of *Agrilus*, *Lampra*, and *Anthaxia* present a similar sculpturing.

* Quart. Journ. Geol. Soc., Nov. 1855, p. 566.

Explanation of the Plates.

PLATE LV.

Fig. 1. *Sphæria lignitum*, m.; fig. 2, magnified; fig. 3, more magnified. Fig. 4 *a*, *b*, *c*, *d*. *Pecopteris lignitum*, Gieb. Fig. 4 *e*. *Cinnamomum Scheuchzeri*, Hr. Figs. 5 & 6. *Pecopteris lignitum*. Figs. 7–10. *Palmacites Dæmonorops*, the fibrous bundles of the stem; figs. 11 & 12, spatha with spines; fig. 11 *b*, magnified; fig. 13, a spine; figs. 14 & 15, spines; fig. 15 *b*, magnified.

PLATE LVI.

Figs. 1–11. *Pecopteris lignitum*, Gieb.:—Fig. 1, the point of a leaflet (pinnula), magnified; figs. 2–4, parts of leaflets near the apex; fig. 5, many fragments of leaflets; fig. 5 *b*, seed, and *c*, the scales of a cone of *Sequoia Couttsiæ*; figs. 6 & 7, base of the leaflets; fig. 8, leaflet restored; figs. 9–11, young fronds. Figs. 12–15. *Lastræa Stiriaca*, Ung., sp.; fig. 12, fragment of a leaflet; fig. 13, leaflet with the sori, from Monod; fig. 14, pinnated leaf; fig. 15, leaflet.

PLATE LVII.

Figs. 1–7. *Pecopteris lignitum*, magnified. Fig. 8. *Lastræa Stiriaca*, magnified.

PLATE LVIII.

Fig. 1. Rhizome of *Pecopteris lignitum*; fig. 2, rachis, with scars of the roots. Fig. 3. *Pecopteris Hookeri*, m.

PLATE LIX.

Sequoia Couttsiæ, m.:—Fig. 1, cone and seeds; fig. 2, cone, magnified; fig. 3, scales of the cone, magnified; fig. 4, scales of the cone; fig. 5, young shoots; figs. 6–8, young shoots, magnified; fig. 9, biennial branch; figs. 10 & 11, older branches; fig. 12, young shoot with the leaves, magnified; fig. 13, branch with three shoots in a verticil; figs. 14, 16 & 18, cones; figs. 15, 17 & 19, these cones restored.

PLATE LX.

Figs. 1–46. *Sequoia Couttsiæ*, m.:—Figs. 1 & 2, biennial branches; figs. 3–6, young shoots; fig. 6 *b*, magnified; fig. 7, base of a young shoot, magnified; fig. 8, young shoot, magnified; figs. 9, 11 & 12 *a*, young shoots with spreading leaves; figs. 11 *b* & 12 *a a*, magnified; fig. 10, young shoot with adnate leaves; figs. 12 *b b* & 13, part of a branch with short adhering leaves, magnified; figs. 14–20, young shoots; fig. 14 *b*, leaf, magnified; figs. 21, 23 & 24, scales of a cone; fig. 22,

base of cone; fig. 25, scale with the seeds; figs. 26–28, cones with separate scales; figs. 29–34, scales of cones; fig. 35 *a*, scales; fig. 35 *b*, seed; figs. 36–42, seeds; fig. 41 *b*, magnified. Fig. 43. *Amentum masculinum*; fig. 43 *b*, magnified; figs. 44 & 45, young shoots from Armissan; fig. 46, magnified. Figs. 47 & 48. *Sequoia sempervirens*; fig. 47, seed; fig. 47 *b*, magnified; fig. 48, cone. Fig. 49. *Glyptostrobus europæus*, Br., sp., from Hohe Rhonen; fig. 49 *b*, magnified. Fig. 50. *Palmacites Dæmonorops*, Ung., sp., fruit; figs. 51–53, magnified. Fig. 54. *Cyperites deperditus*, Hr.; fig. 54 *b*, magnified.

PLATE LXI.

Sequoia Couttsiæ, m., restored.

PLATE LXII.

Palmacites Dæmonorops, Ung., sp.:—Fig. 1, a large specimen, spatha?; fig. 2, three of the spines, magnified; fig. 3, a specimen with five spines; figs. 4–6, little spines; fig. 7, fasciculi of spines; fig. 8, spines lying in different directions; figs. 9–11, spines, magnified; fig. 9 *b*, a portion more magnified.

PLATE LXIII.

Fig. 1 *b*. *Lastræa Bunburii*, m., nat. size; *c*, *d*, magnified. Fig. 1 *a*. *Ficus Falconeri*, m.; fig. 1 *a a*, a portion of the surface of the leaf, magnified; fig. 1 *a a a*, more magnified. Figs. 2–9. *Quercus Lyelli*, m.; fig. 2, apex of the leaf; figs. 3, 8 & 9, base; figs. 4–7, middle piece; fig. 7 *b*, portion of leaf, magnified.

PLATE LXIV.

Fig. 1 *a*, *b*, *c*. *Quercus Lyelli*, m. Fig. 1 *d*. *Phragmites œningensis*, A. Br.? Figs. 2, 3 & 4. *Quercus Lyelli*. Fig. 3 *b* & 5. *Echitonium cuspidatum*, Hr. Figs. 6 & 7. *Ficus Falconeri*, m.

PLATE LXV.

Figs. 1 & 2. *Daphnogene Ungeri*, Hr. Figs. 3–5. *Ficus eucalyptoides*, m. Fig. 6. *Laurus primigenia*, Ung. Figs. 7 & 8. *Ficus Pengellii*; figs. 7 *b* & 8 *b*, a portion of leaf, magnified. Figs. 9–11. *Dryandroides lævigata*, Hr. Fig. 12 *a*. *Dryandroides hakeæfolia*, Ung. Fig. 12 *b*. *Quercus Lyelli*. Fig. 12 *c*. *Echitonium cuspidatum*, Hr. Fig. 13 *a*. *Phragmites œningensis*, A. Br.; 13 *a a*, magnified. Fig. 13 *b*. *Dryandroides lævigata*. Fig. 13 *c*. *Sphæria socialis*, m.; fig. 13 *c c*, magnified.

PLATE LXVI

Figs. 1 & 2. *Quercus Lyelli*, m., restored. Fig. 3. *Ficus Pengellii*, m., restored. Fig. 4. *Ficus Falconeri*, m., restored.

PLATE LXVII.

Figs. 1–8. *Cinnamomum lanceolatum*, Ung., sp. Figs. 9–16. *Cinnamomum Scheuchzeri*, Hr.; fig. 12, branch with the flowers, from Oeningen. Figs. 17 & 18. *Cinnamomum Rossmässleri*, Hr. Fig. 19. *Sclerotium Cinnamomi*, m., magnified; fig. 19 *b*, transverse section.

PLATE LXVIII.

Fig. 1. *Palmacites Dæmonorops*? portion of leaf; fig. 1 *b*, five times magnified. Fig. 2. *Phragmites œningensis*, A. Br.? Fig. 3. *Poacites*, spec. Figs. 4 & 5. *Quercus Lyelli*; fig. 6, bark. Fig. 7. *Dryandroides Banksiæfolia*, Ung., sp.? Fig. 8. *Vaccinium acheronticum*, Ung. Fig. 9. *Andromeda vacciniifolia*, Ung. Figs. 10 & 11. *Andromeda reticulata*, Ett.; fig. 10 *b*, magnified. Figs. 12 & 13. *Cinnamomum Scheuchzeri*; figs. 13 & 13 *c*, flowers; fig. 13 *b*, *d*, magnified. Figs. 14 & 15. *Cinnamomum lanceolatum*. Figs. 16–18. *Eugenia Hæringiana*, Ung. Fig. 19. *Celastrus pseudo-ilex*, Ett. Fig. 20. *Leguminosites areolatus*, m.; fig. 20 *b*, magnified. Fig. 21. *Buprestites Falconeri*, m.; fig. 21 *b*, magnified.

PLATE LXIX.

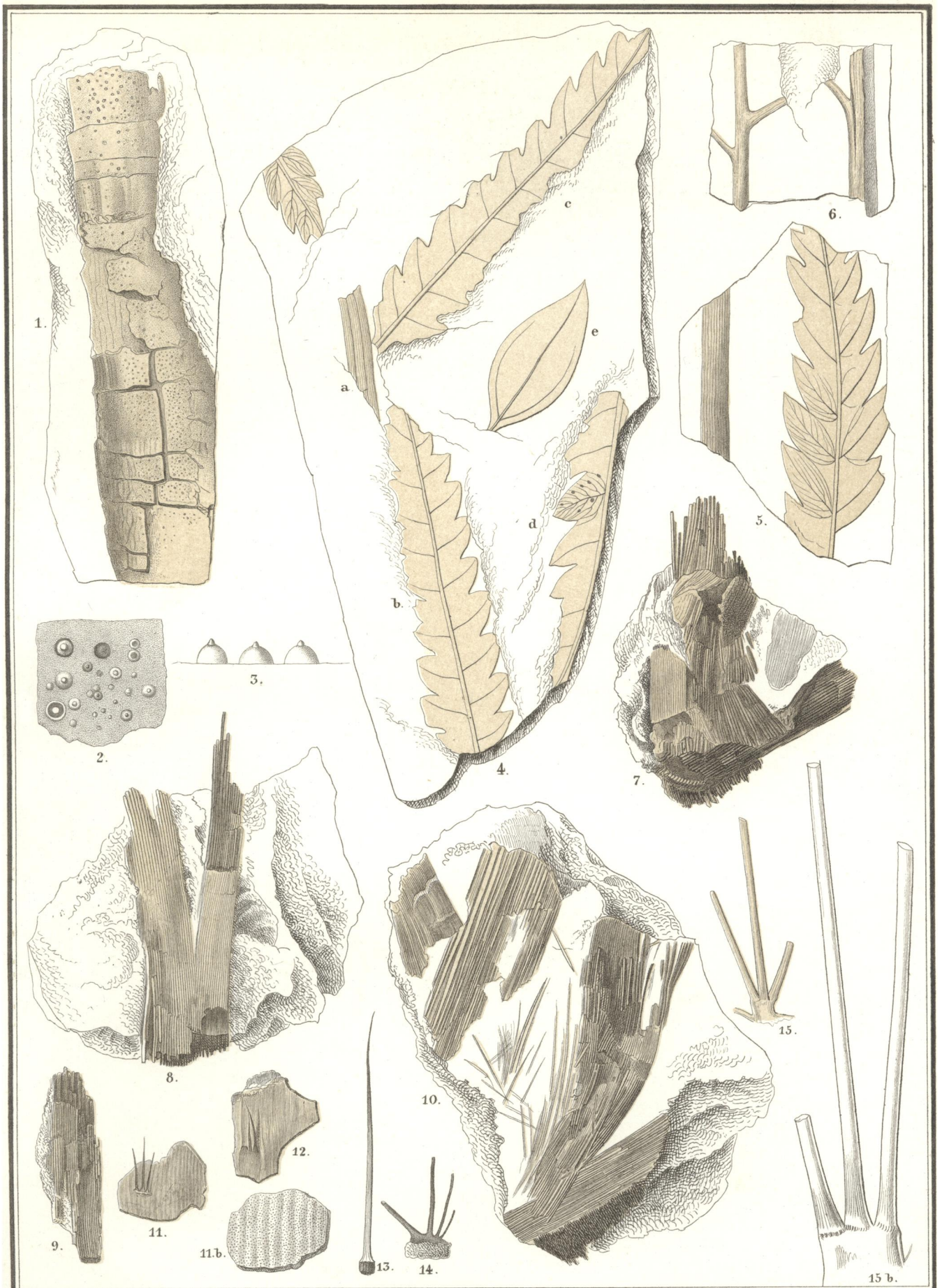
Figs. 1–8. *Gardenia Wetzleri*; figs. 3–6, seeds, magnified; fig. 7 *a*, *b*, seed-vessel from Samland; fig. 7 *c*, transverse section; fig. 8, fruit from Günzburg. Figs. 9 & 10. *Eucalyptus oceanica*, Ung.? Figs. 11–17. *Nyssa europœa*; figs. 12 *b* & 17 *b*, magnified. Fig. 18. *Nyssa lævigata*; fig. 18 *b*, magnified. Fig. 20–23. *Nyssa striolata*; fig. 20 *b*, magnified. Fig. 24. *Nyssa microsperma*, m.; fig. 24 *b*, magnified. Figs. 25 & 26. *Vitis britannica*, m.; fig. 26 *b*, magnified. Figs. 27 & 28. *Vitis Hookeri*, m., fruit; figs. 29 & 29 *b*, seed; fig. 29 *c*, *d*, magnified; fig. 29 *e*, transverse section. Fig. 30. *Carpolithes scutellatus*, m.; fig. 30 *b*, magnified.

PLATE LXX.

Figs. 1–3. *Anona devonica*, m.; figs. 1 *b* & 2 *b*, transverse section. Figs. 4 & 4 *b*. *Anona cyclosperma*, m. Fig. 5. *Pterocarya denticulata*, O. Web., sp.?; fig. 5 *b* & *c*, magnified. Fig. 6. *Carpolithes Websteri*, Br.; fig. 6 *b*, magnified; fig. 6 *c*, *d*, *e*, portion of the membrane, highly magnified. Figs. 7–14. *Carpolithes Boveyanus*, m.; figs. 8 *b*, 12 *b* & 13 *b*, magnified; figs. 9 *b* & 13 *b*, vertical sections. Figs. 15–23. *Carpolithes nitens*, m.; figs. 17 *b* & 15 *b*, base of the fruit, magnified; fig. 19, transverse section; fig. 19 *b*, magnified; fig. 20, transverse section near the apex; fig. 20 *b*, magnified; figs. 21 & 22, transverse section from the middle of the fruit; fig. 23, many fruits, of natural size. Figs. 24–27. *Carpolithes exaratus*, m.; figs. 24–26, magnified. Figs. 28 & 29. *Carpolithes vinaceus*, m.; fig. 29 *b*, magnified. Figs. 30 & 30 *c*. *Carpolithes lividus*, m.; fig. 30 *c*, magnified. Figs. 32–37. *Nymphœa Doris*, m.; figs. 34 & 36, magnified; fig. 37, highly magnified.

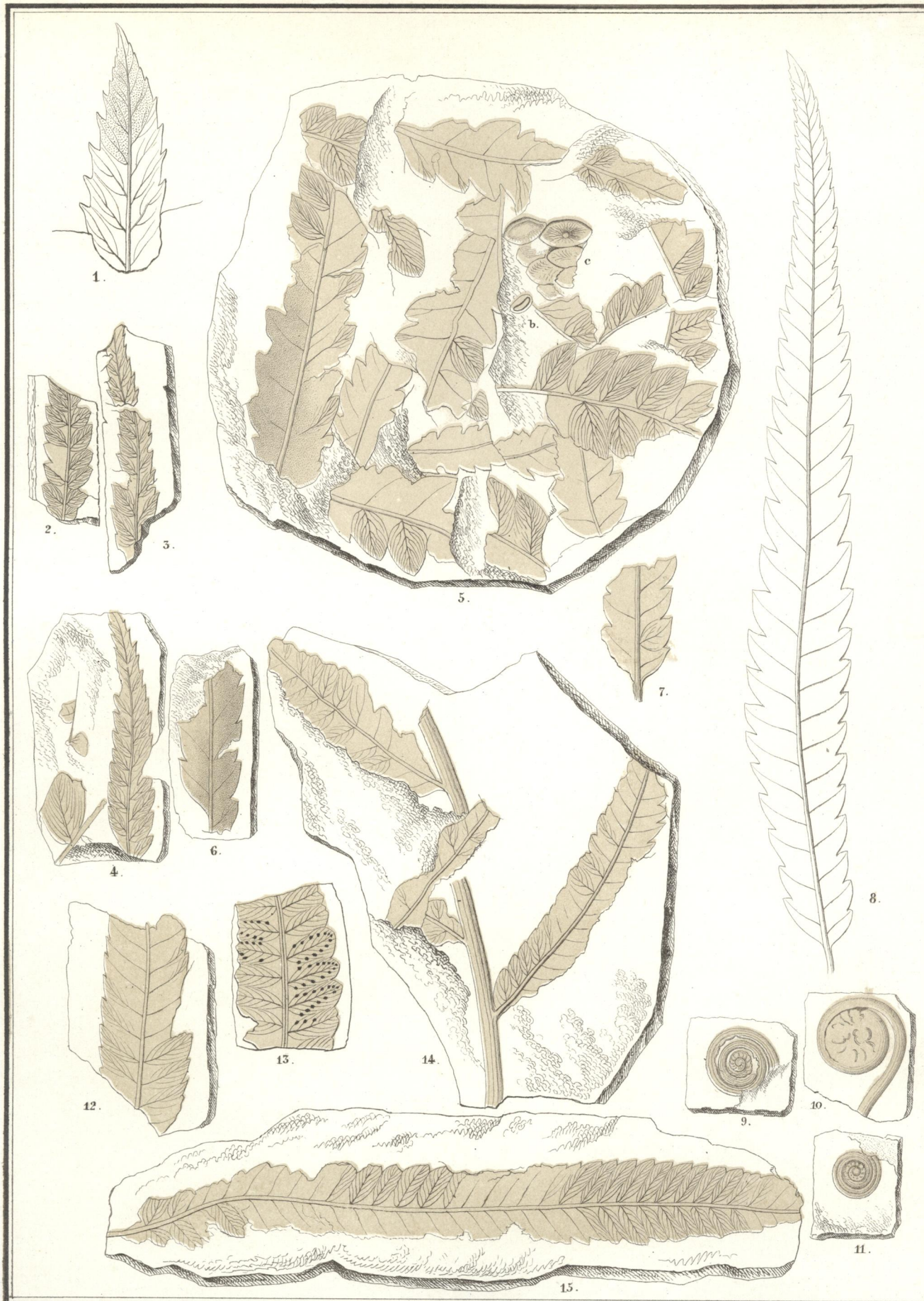
PLATE LXXI.

Fig. 1 *a*, *b*. *Salix cinerea*, Linn.; fig. 1 *c*–*h*. *Salix repens*, Linn.? fig. 1 *k*. *Betula nana*, Linn.; fig. 1 *k k*, magnified. Figs. 2 & 3. *Salix cinerea*, Linn. Figs. 4 & 5. *Salix*, sp. Fig. 6. *Salix repens*, Linn.? Fig. 7 *a*. *Betula nana*, Linn. Fig. 7 *b*. *Salix repens*, Linn.? Figs. 8 & 9, very highly magnified portion of wood.



Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

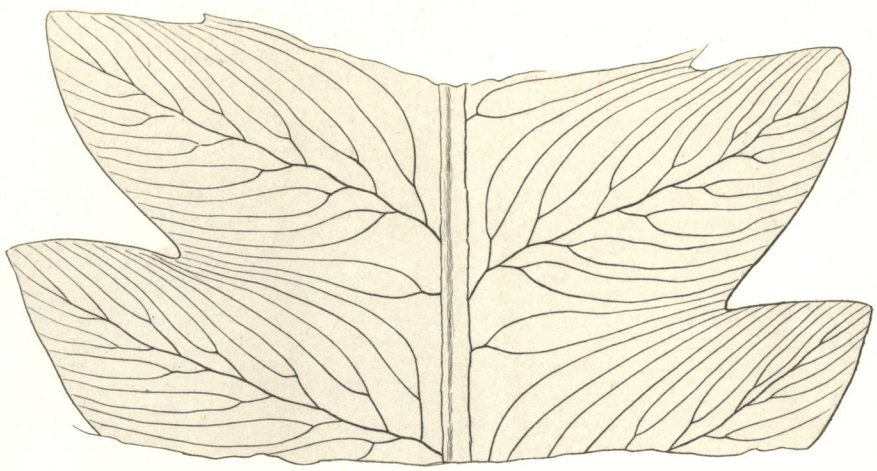
1. 2. 3. Sphaeria lignitum. 4 a–d. Pecopteris lignitum. 4. e. Cinnamomum Scheuchzeri. 5. 6. Pecopteris lignitum. 7–15. Palmacites Daemonorops.



P. Brugier del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

1–11. Pecopteris lignitum 12–15. Lastraea stiriaca. 5.b.c. Sequoia Couttsiae.



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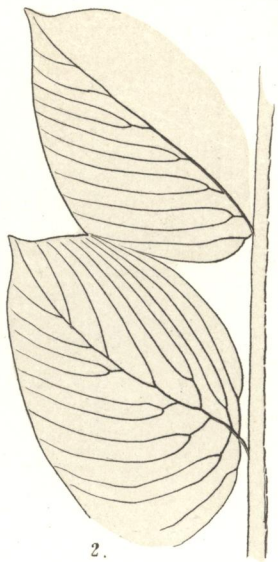

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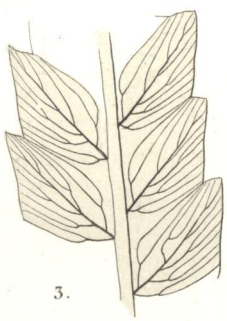

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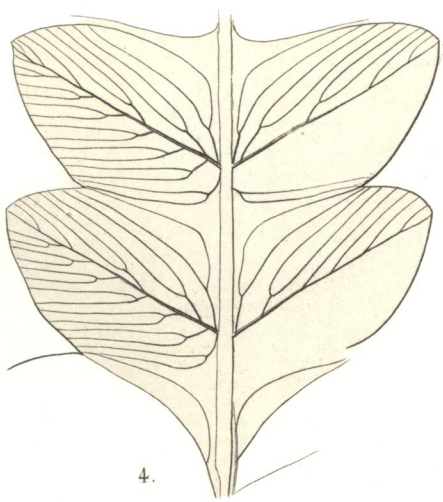

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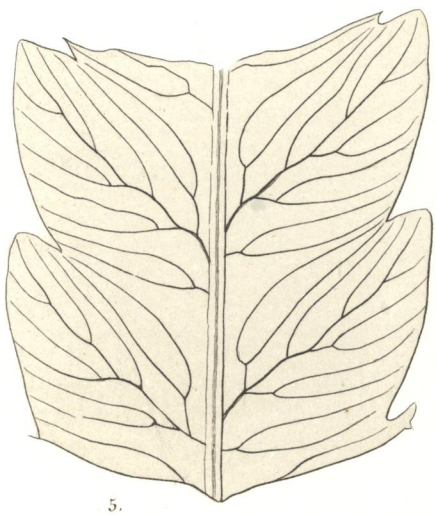

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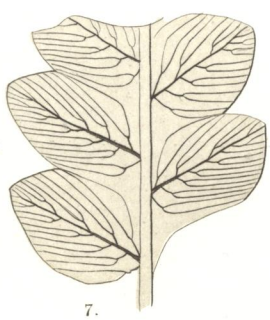

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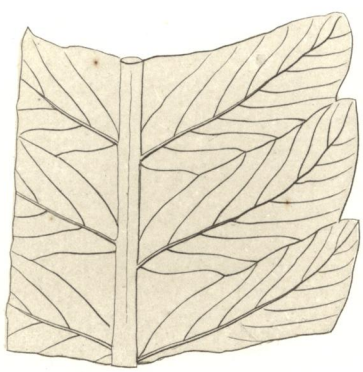
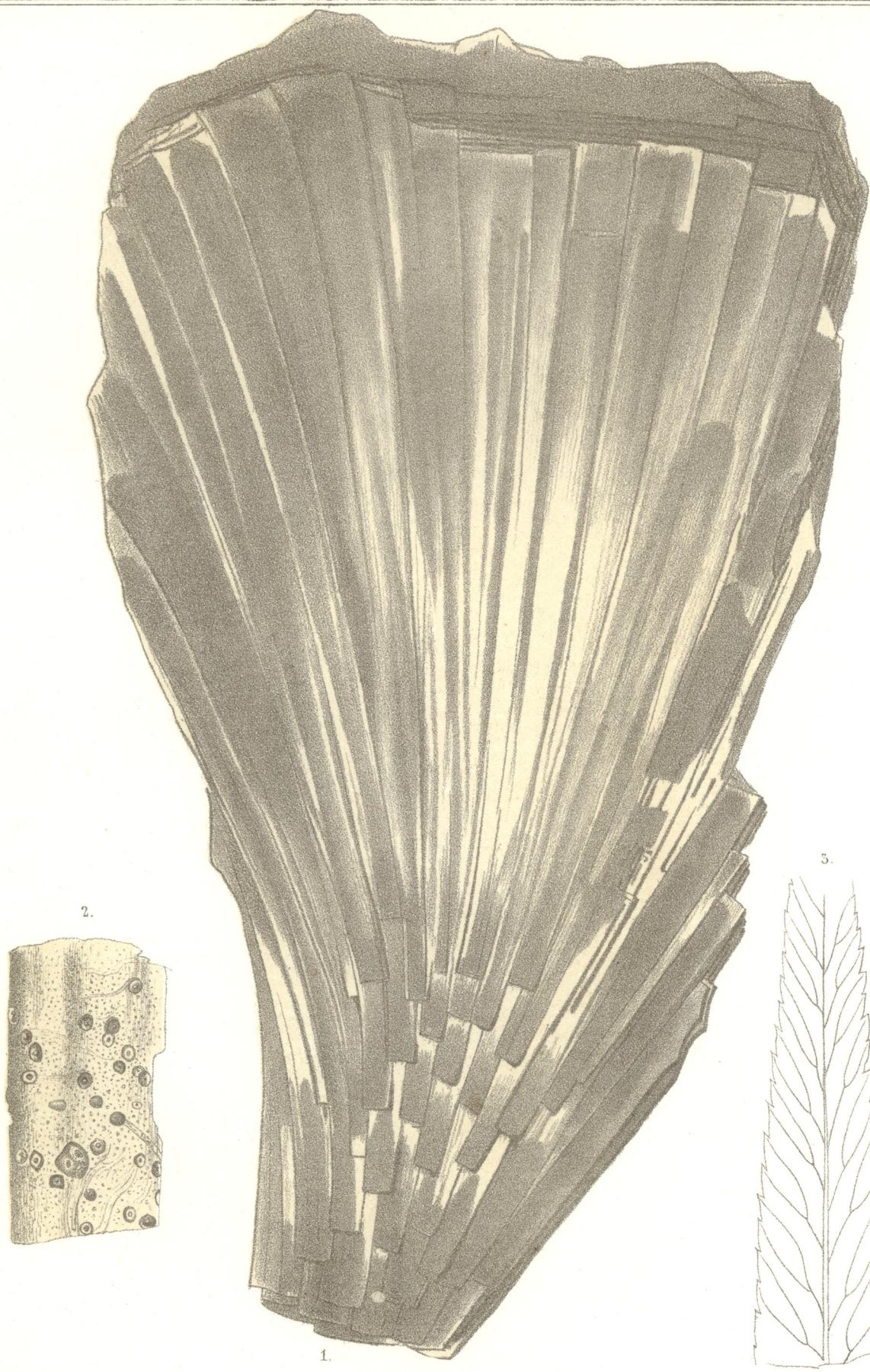


8.

Ch. Th. Gaudin et W. Fitch del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

1–7. Pecopteris lignitum. 8. Lastraea stiriaca.



2.

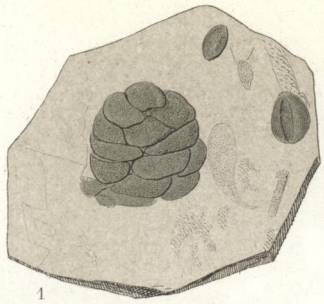
3.

1.

W. H. Fitch del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur

1–2 Pecopteris lignitum. 3. Pecopteris Hookeri.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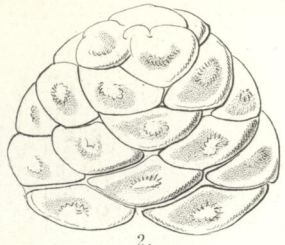
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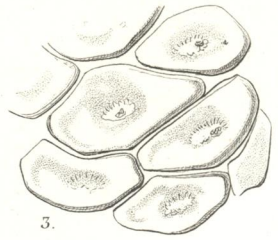
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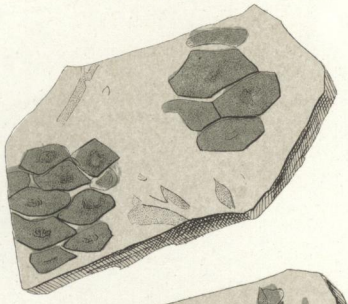
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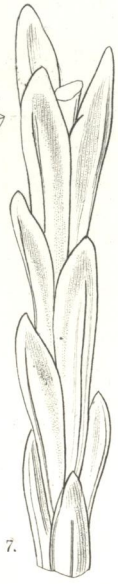
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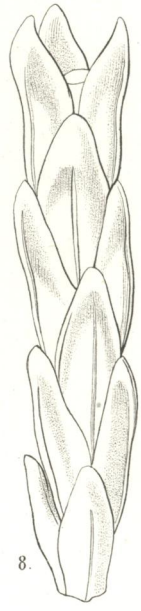
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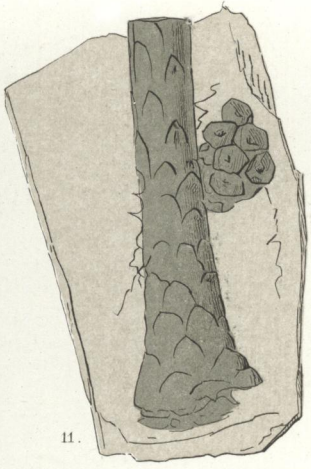
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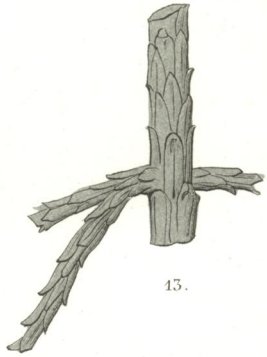
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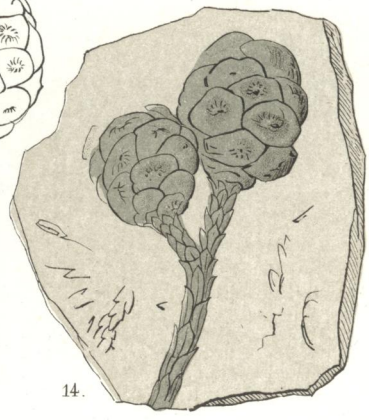
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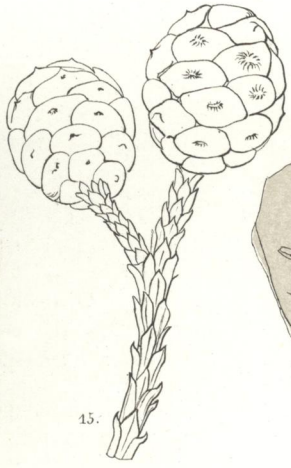
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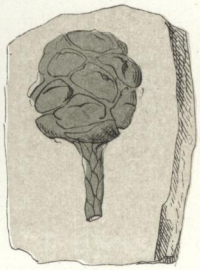
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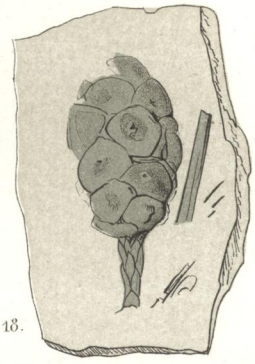

18.


19.

W. H. Fitch del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

Sequoia Couttsiae.

P. Brugier del.

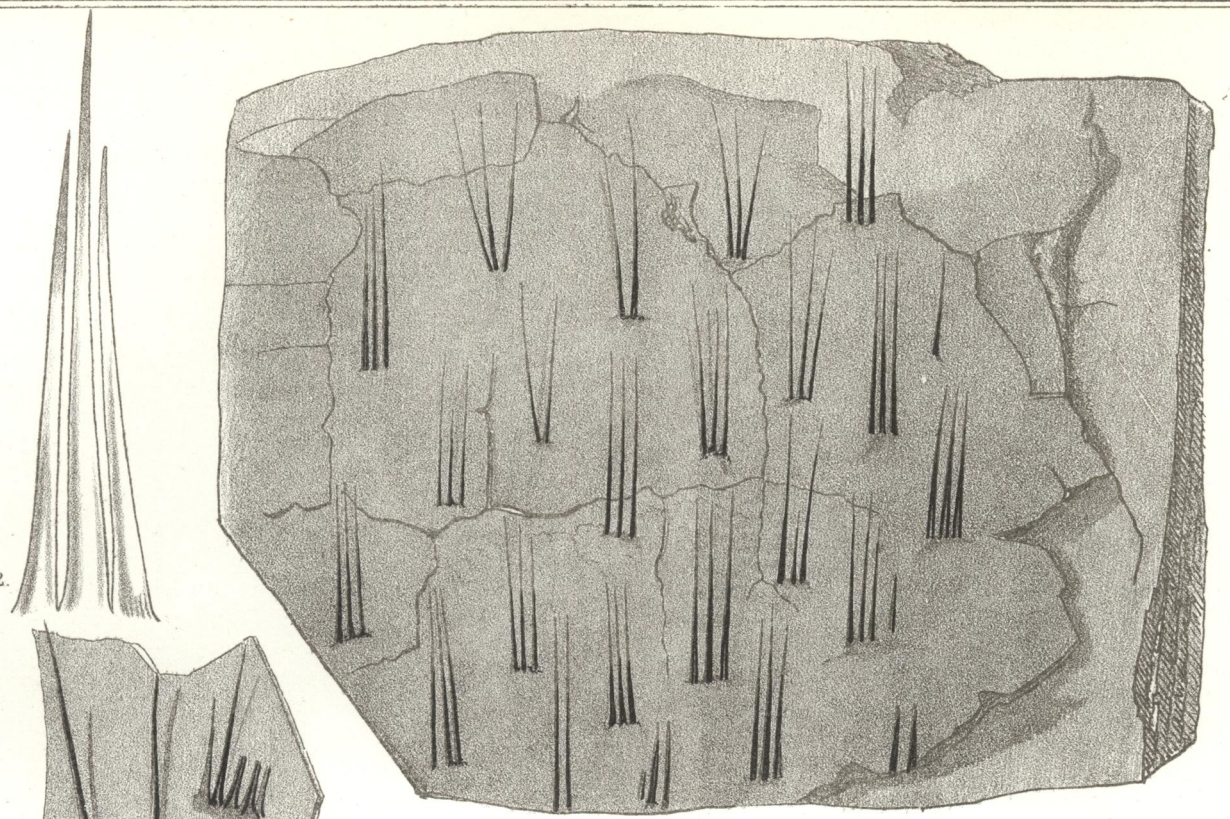
Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

1–46. Sequoia Couttsiae. 47. 48. Sequoia sempervirens. 49. Glyptostrobus europaeus. 50–53. Palmacites Daemonorops ?. 54. Cyperites deperditus.

P. Brugier del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

Sequoia Couttsiæ.



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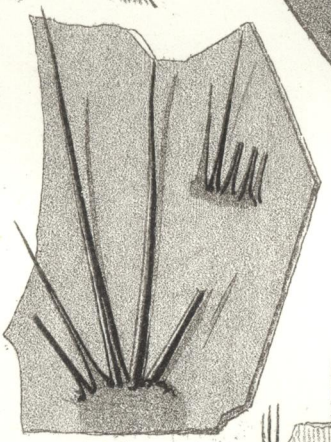

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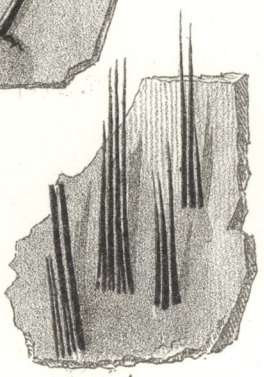

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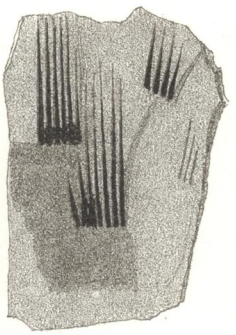

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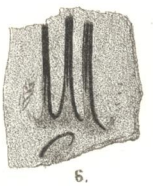

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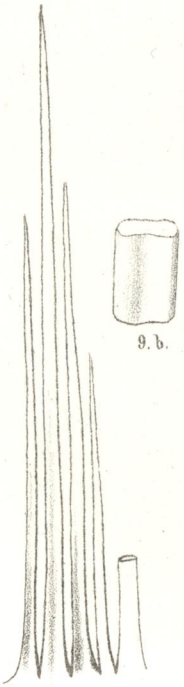
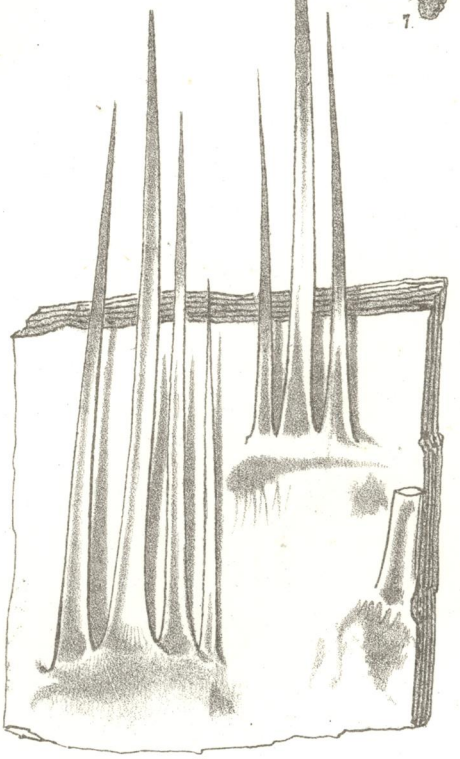


9.

9. b.

8.

10.



11.

W. H. Fitch del.

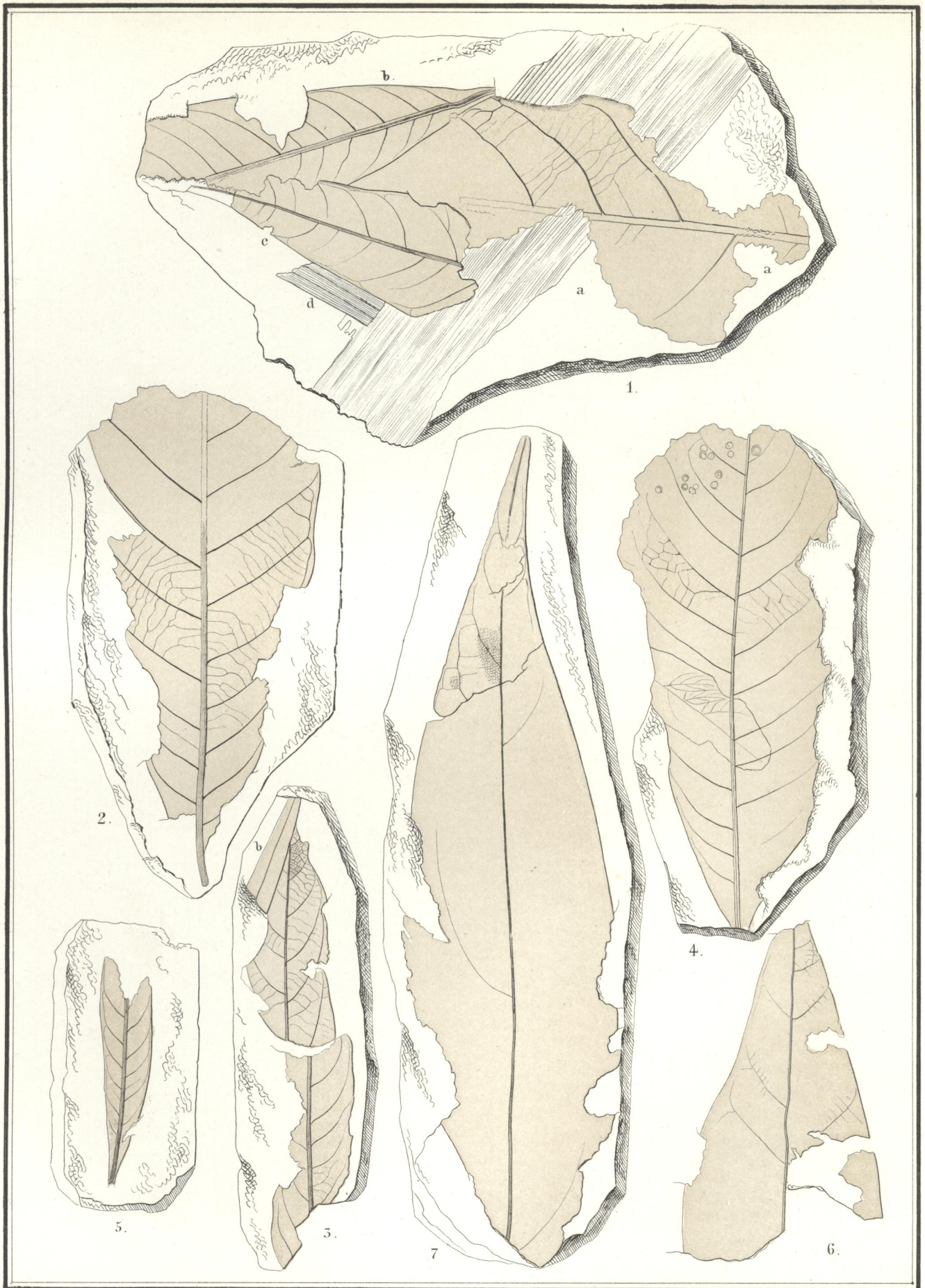
Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

Palmacites Daemonorops

P. Brugier del.

Lith. Anstalt v J. Wurster u. Comp. in Winterthur.

1. b. d. Lastraea Bunburii. 1. a. Ficus Falconeri 2–9. Quercus Lyelli.



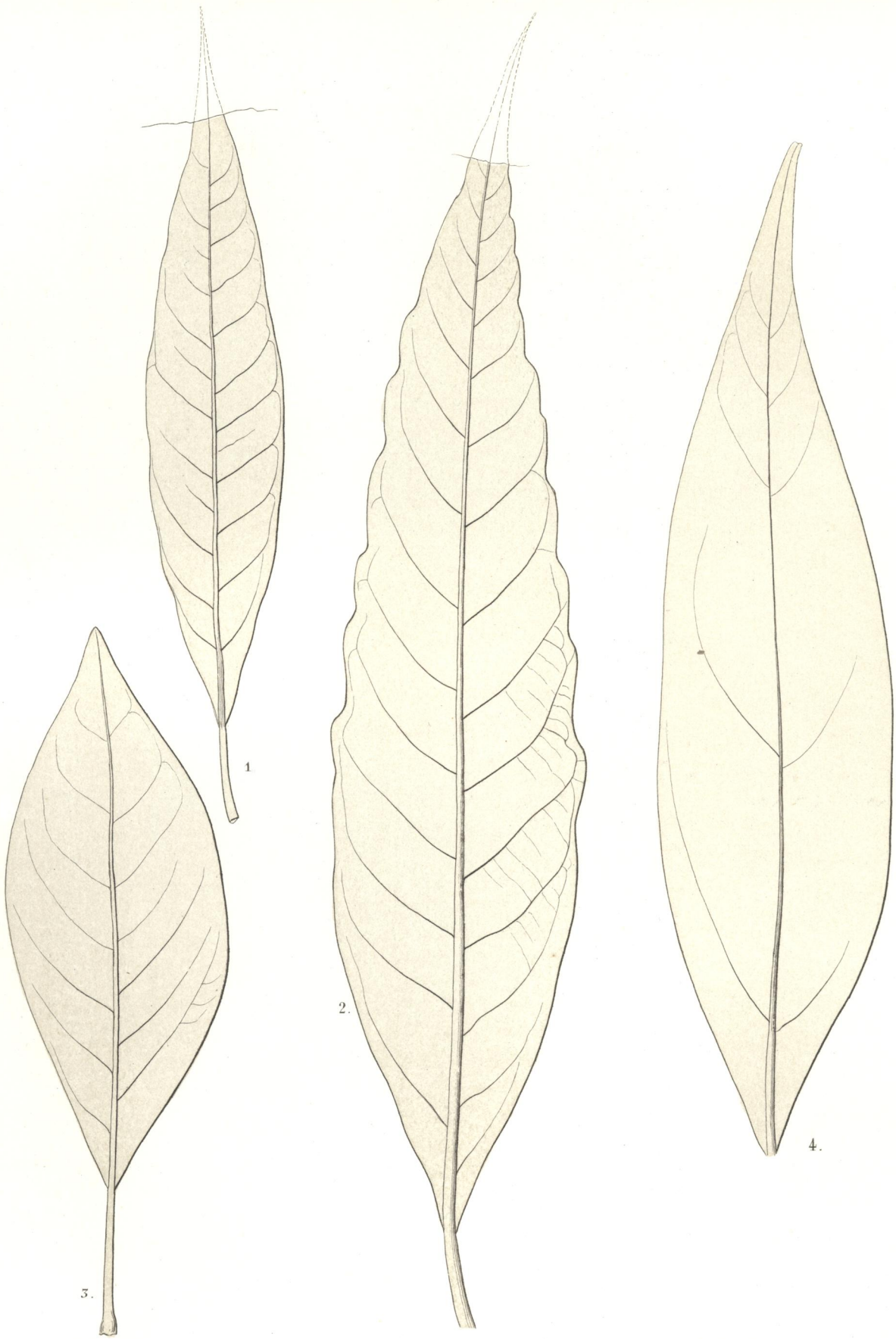
P. Brugier del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

1. a.b.c. Quercus Lyelli. 1.d. Phragmites oeningensis 2.3.a.4. Quercus Lyelli. 3.b.5. Echitonium cuspidatum. 6.7. Ficus Falconeri.

P. Brugier del. Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

1. 2. Daphnogene Ungeri 3. 4. 5. Ficus eucalyptoides, 6. Laurus primigenia 7. 8. Ficus Pengellii. 9–11. Dryandroides laevigata. 12.a. Dryandroides hakeaefolia. 12.b. Quercus Lyelli 12.c. Echitonium cuspidatum. 13.a. Phragmites oeningensis ? 13.b. Dryandroides laevigata. 13.c. Sphaeria socialis.



Brugier del.

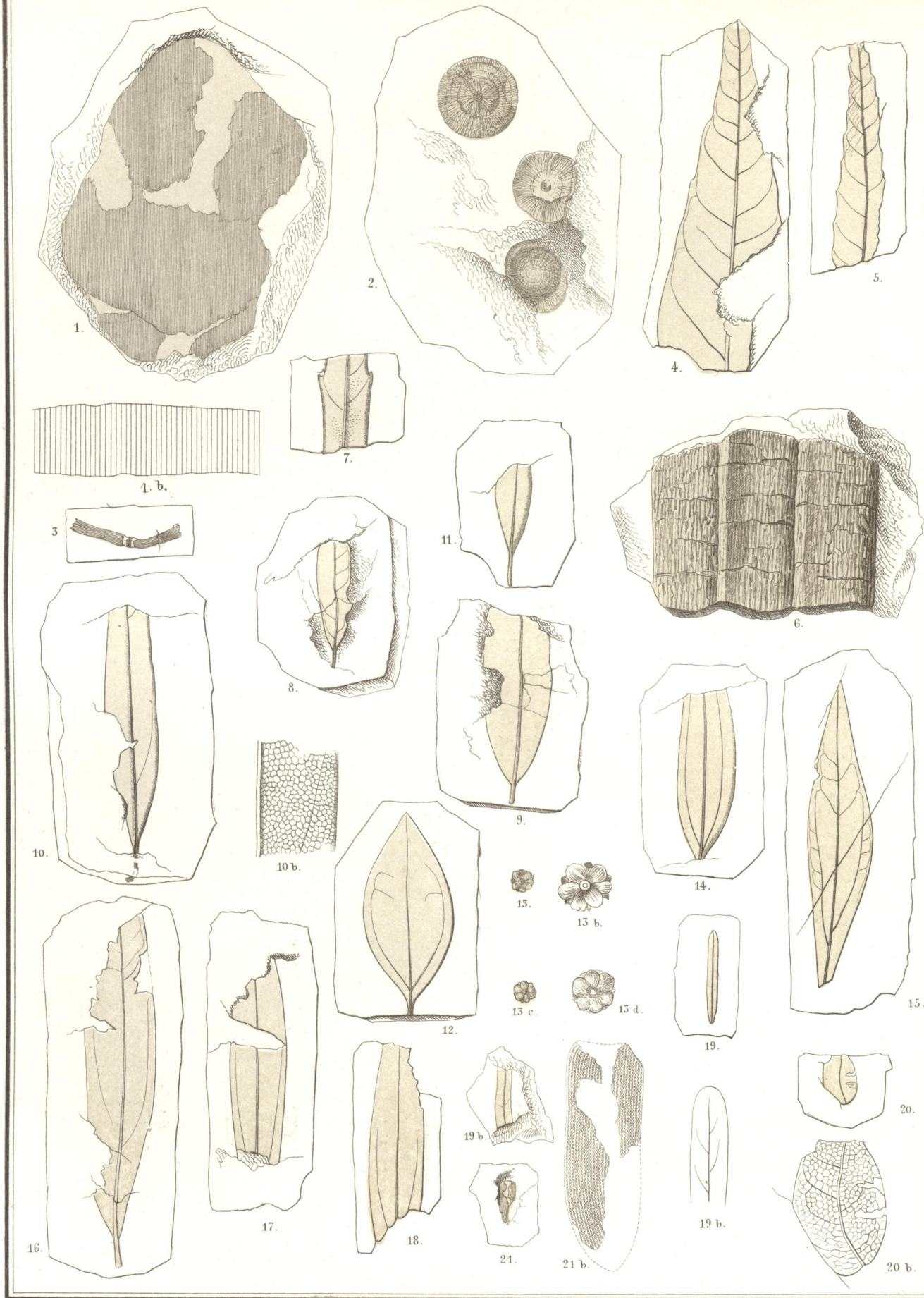
Lith. Anstalt von J. Wurster u. Comp. in Winterthur.

1. 2. Quercus Lyelli. 3. Ficus Pengellii. 4. Ficus Falconeri.

P. Brugier del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

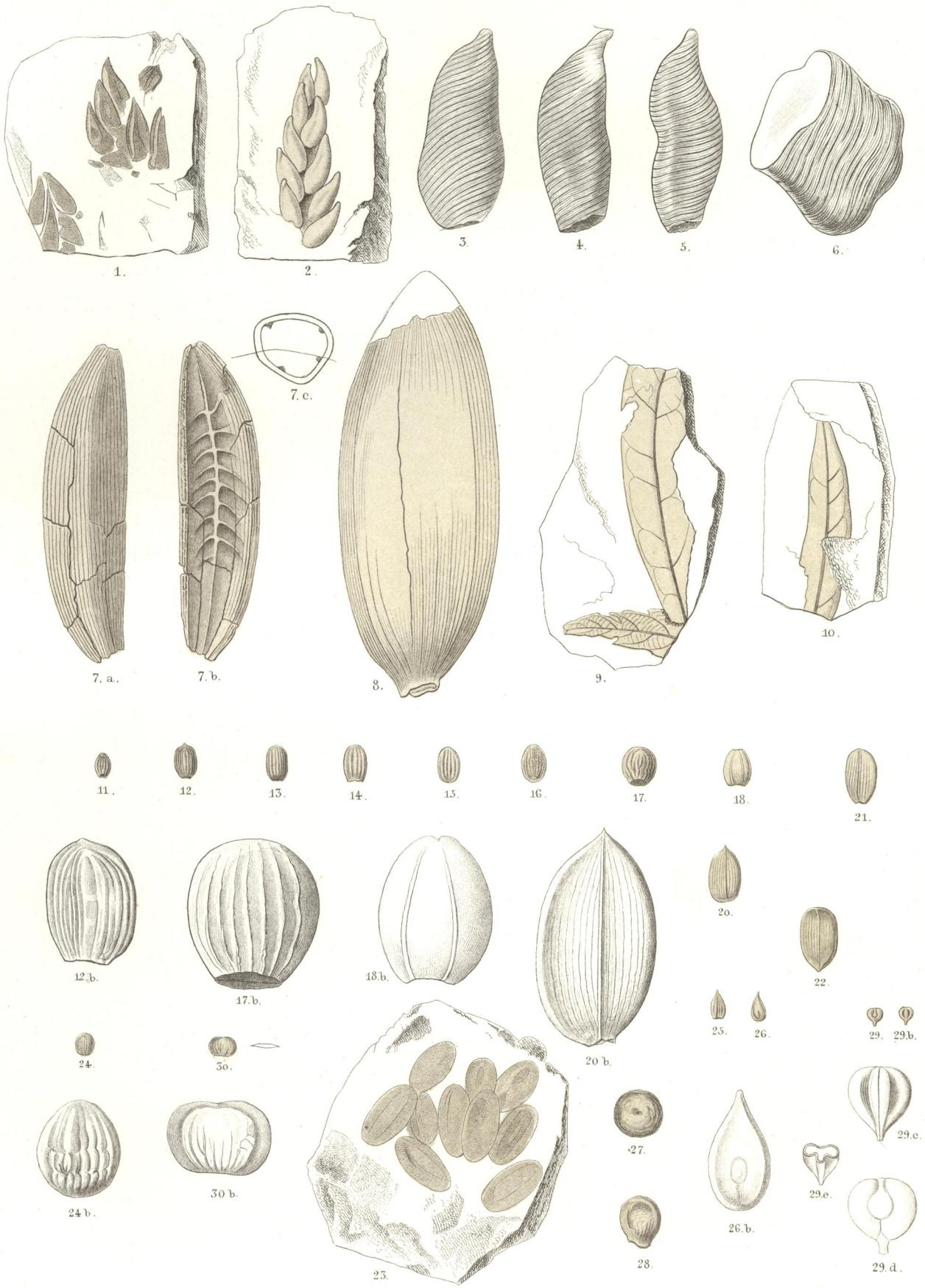
1 _ 8. Cinnamomum lanceolatum. 9_16. Cinnamomum Scheuchzeri. 17.18. Cinnamomum Rossmässleri. 19. Sclerotium Cinnamomi.



P. Brugier del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

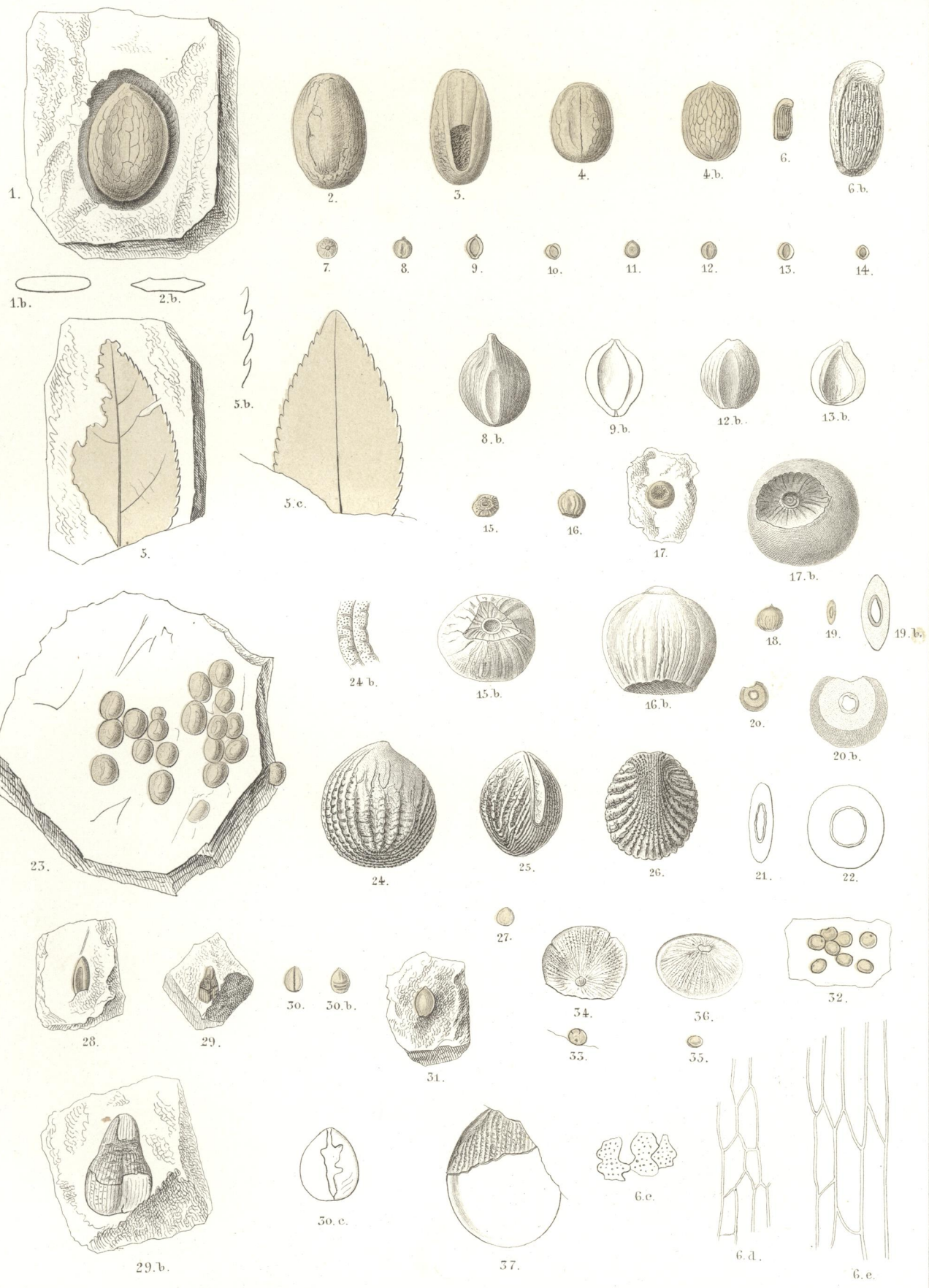
1. Palmacites Daemonorops ? 2. Phragmites oeningensis ? 3. Poacites. 4.5.6. Quercus Lyelli. 7. Dryandroides banksiaefolia ? 8. Vaccinium acheronticum. 9. Andromeda vaccinifolia. 10. 11. Andromeda reticulata. 12. 13. Cinnamomum Scheuchzeri. 14. 15. Cinnamomum lanceolatum. 16. 17. 18. Eugenia haeringiana. 19. Celastrus pseudoilex. 20. Leguminosites areolatus. 21. Buprestites ? Falconeri.



P. Brugier del.

Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

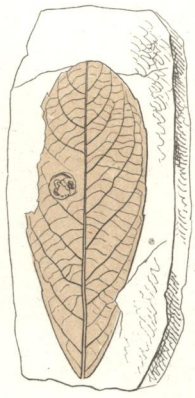
1–8. Gardenia Wetzleri. 9. 10. Eucalyptus oceanica ?. 11–17. Nyssa europaea. 18. Nyssa laevigata. 20–23. Nyssa striolata. 24. Nyssa microsperma. 25. 26. Vitis britannica. 27. 28. 29. Vitis Hookeri. 30. Carpolithes scutellatus.

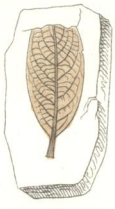


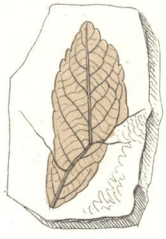
F. Brugier del.

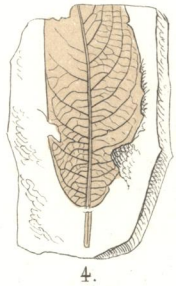
Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

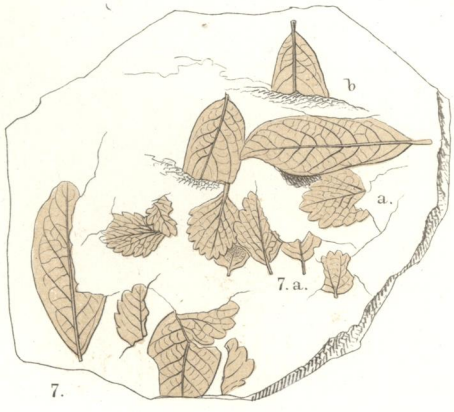
1–3. Anona devonica. 4. Anona cyclosperma. 5. Pterocarya denticulata ? 6. Carpolithes Websteri. 7–14. Carpolithes Boveianus. 15–25. Carpolithes nitens. 24–27. Carpolithes exaratus. 28. 29. Carpolithes vinaceus. 30. 31. Carpolithes lividus. 32–37. Nymphaea Doris.

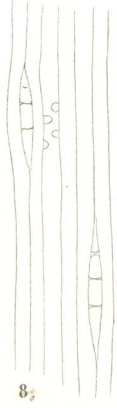


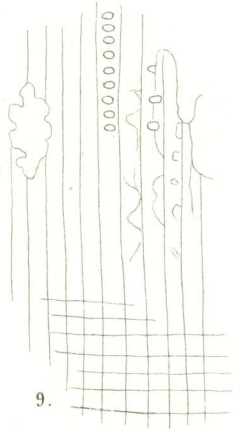












Lith. Anstalt v. J. Wurster u. Comp. in Winterthur.

1. k. Betula nana. 1. a. b. Salix cinerea. 1 c–h. Salix repens L.? 2. 3. Salix cinerea 4. 5. Salix sp. 6. 7. Salix repens L.? 7. a. Betula nana.